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# DEFENSE INTELLIGENCE AGENCY INTEGRATED SCHEDULING SYSTEM

Science Applications International Corporation

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**13. ABSTRACT (Maximum 200 words)**
This report documents the study and analyses conducted in the development of requirements for an Integrated Scheduling System (ISS) to satisy integration management, planning and scheduling responsibilities of DIA/DS. The ISS will be the primary tool used by the Systems Integration Management Office (DS-SIMO) as it focuses on interfaces, dependencies and integration among the projects and segments comprising the DIA Information System (DIS). Included in this effort was data collection and analysis of designated DIS projects, their dependencies and interfaces; the development and implementation of a prototype data base concept (SIMOCODE) and structure (SIMODATA) focused on unique DIA requirements; the identification of DIS integration management requirements; and a review and analysis of government-owned and commercially available capabilities for satisfying the DIA requirements.

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AIRES | Advanced Imagery Requirements and Exploitation System |
| AIS | Automated Information System |
| ALE | AIRES Life Extension |
| AREV | Advanced Revelation |
| CAMP | Communications and Message Processor |
| CBS | Cost Breakdown Structure |
| CCB | Configuration Control Board |
| COTR | Contracting Officer Technical Representative |
| COTS | Commercial, Off-The-Shelf |
| DBMS | Data Base Management System |
| DCD | Dependency Control Document |
| DIA | Defense Intelligence Agency |
| DIA-ISS | An automated integration management system being developed for the DIS. |
| DIAOLS | DIA On-Line System |
| DID | Data Item Description |
| DIS | DIA Information System |
| DS | Director of Information Systems |
| DS-CCB | Top level DIA CCB for configuration management of AIS. |
| DS-SIMO | Office symbol for SIMO |
| GFE | Government Furnished Equipment |
| GFI | Government Furnished Information |
| IBM | International Business Machines |
| ISS | Integrated Scheduling System |
| NMIC | National Military Intelligence Center |
| NSS | NMIC Support System |
| OBS | Organizational Breakdown Structure |
| PC | Personal Computer |
| PMS | Project Management System |
| QA | Quality Assurance |
| SAIC | Science Applications International Corporation |
| SBS | Schedule Breakdown Structure |
| SIMO | System Integration Management Office |
| SIMOCODE | dBase IV data base code developed for DS-SIMO |
| SIMODATA | Data structure used by SIMOCODE |
| SRS | Software Requirements Specification |
| SYBASE | A distributed relational DBMS |
| SYNERGY | A Bectel Corp. Project Control System |

| | |
|---|---|
| TBS | Technical Breakdown Structure |
| VM/XA | Virtual Memory/eXtended Architecture |
| WBS | Work Breakdown Structure |

# 1.0 EXECUTIVE SUMMARY

## 1.1 Background

Management of the Defense Intelligence Agency (DIA) Information System (DIS) development process and post-deployment support of continuing operations is a complicated process. It involves interactive management and coordination among the users, the DIS Segment Managers, individual Project Managers, and those charged with integration management (DS-SIMO). The DIA Director of Information Systems (DS) and the Systems Integration Management Office (DS-SIMO) must be able to assess the impact of each new system or each change to an existing application as it is being developed and as it enters the operational environment to effectively balance the demands of DIA needs with increasingly limited resources. They must maintain cognizance of schedules, costs, security issues, testing, training and maintenance needs, as well as the impact on resource requirements and operational capabilities.

The complexities of the current and planned environments can best be characterized by the myriad of developers, schedules, interfaces, dependencies and differences in technical design. The complications associated with managing current status within this environment are hindered by the non-standard and manual means of communicating and coordinating among project managers and to senior management. This situation is further complicated by the diversity of automation tools used to manage status at the project, segment and system levels. Consequently, the development and implementation of common terminology, definitions, and standards within a structured integration management methodology has become imperative. Focusing on interfaces and project dependencies to facilitate communications and coordination among end users, developers and acquisition/procurement organizations is also imperative. To do this effectively requires consolidating as much integration management information as possible into a single integration management system. An Integrated Scheduling System (ISS) is the first step in implementing such a capability.

## 1.2 Accomplishments

### 1.2.1 Data Collection and Analysis

Science Applications International Corporation (SAIC) completed the initial data collection and analysis on 71 DIS projects comprising 17 functional segments in July, 1990 with monthly updates continuing through March, 1991. A dBase IV data base contains all project milestones and dependency relationships defined. From this source, 17 DIS Master Segment Schedules, the DIS Project Interdependency Schedule and the DIS GFE/GFI Interdependency Schedule graphically portray baselined milestones and dependencies. This DIS Summary Status Report and 17 Segment Status Assessments reflect the DS-SIMO assessed health of the projects, segments, and the DIS in the aggregate. The real point and value of this data collection and analysis activity, however, was in establishing the basis for the DIA-ISS requirements in support of integration management needs.

SAIC supported four special-interest projects during this period of performance. For the Communications and Message Processor (CAMP), the National Military Intelligence Center (NMIC) Support System (NSS) Termination, the DIA On-line System (DIAOLS) Termination and the Virtual Memory/eXtended Architecture (VM/XA) Implementation projects, the emphasis was on transitioning into or out of operational status. An intensively applied methodology focused on

a. Identifying project objectives, constraints and strategies,

b. Decomposing projects to their lowest contributing activity (four levels deep for DIAOLS and VM/XA),

c. Collecting and analyzing cost, schedule, technical performance, interface and dependency data,

e. Adjusting strategies and deconflicting dependencies,

f. Developing integrated schedules to best meet the objectives within the given constraints, and

g. Determining accountability for every event requiring closure.

As a result, those projects were brought under control and testify to the value and necessity of integration management in a complex environment. It reduces uncertainty and risk while producing results that senior management likes.

### 1.2.2 Integration Management Requirements Analysis

The data analysis results were iteratively evaluated using the SAIC-developed Information Systems Integration methodology and an initial set of DIA-ISS requirements were identified. A Project Management Dynamics Model and System Integration Dynamics Model were successively applied to evaluate the relationships of cost, schedule and technical performance within a project's life cycle plus interfaces and dependency relationships among multiple projects when viewed from a systems integration perspective. This exercise enabled SAIC to identify strengths and weaknesses at the project management and integration management levels that needed to be accommodated within the DIA-ISS structure and prioritized for implementation.

To aid in requirements analysis and to evaluate implementation alternatives, SAIC developed dBase IV code called SIMOCODE and a supporting data base structure called SIMODATA. The success of this approach led to the decision to document the DIA-ISS data base management system (DBMS) requirements as the Software Requirements Specification for the SIMOCODE Project and includes the supporting data base structure called SIMODATA.

### 1.2.3 Integration Management System Alternatives Analysis

Two DIA decisions made just prior to starting the period of performance directly affected the scope and direction of this task. Adhering to the DIA/DS policy that automated support tools must be on the DIA list of supported products coupled with a DS-SIMO decision to use the dBase III+ DBMS and Project Workbench software as the project management application greatly refocused this effort. Consequently, SAIC employed these automated tools, subsequently identified limitations experienced in supporting the DS-SIMO mission, and recommended a move to the dBase IV DBMS and the Lotus Freelance Plus graphics capability in the short term. When the source code stabilizes, implementation of Clipper is recommended over dBase IV until a fully integrated data base and graphics generation application is available.

These recommendations are fully consistent with the DIS Architecture for the 1990's, the DIS Architecture Standards and Products, and DIA/DS policy.

In addition, SAIC delivered, as a by-product of the requirements analysis effort, a working prototype of SIMOCODE and SIMODATA. SIMOCODE and SIMODATA can support DS-SIMO near term integration management needs in a standalone environment.

## 1.3 Omissions

The System Integration Management Plan and Automated Information System (AIS) Project Managers Handbook were drafted wholly by DS-SIMO government personnel prior to the start of SAIC's period of performance. Consequently, no measurable effort was expended in preparing these documents.

Because of the changing nature of the project list, the differences in terminology used across DIA organizations, and the inconsistent use of project level details among project managers, SAIC suspended project analysis efforts focused on mapping milestone data into a predefined standard set of milestones prior to populating the prototype data base. Consequently, the time and resources required to maintain the currency of project data already collected was reduced permitting the use of those resources to support requirements synthesis and data base design efforts.

## 1.4 Assessment

SAIC proved that their Information Systems Integration methodology works in the DIS environment and does so at relatively low cost. The initial priorities were focused on project schedule and interproject dependency management of and designed to provide DS with an integrated assessment of the DIS. Consequently, the DS-SIMO now possesses a profile of schedule and dependency-based integration management requirements looking nine to eighteen months in the future. Armed with this and the experience gained over the past fifteen months, DS-SIMO is well postured to assess future operational resource requirements.

Especially germane to this assessment is the experience with the four special-interest projects cited earlier. The resulting benefits were directly proportional to how successfully each project was defined and accountability

established with respect to its integration requirements. Fundamental to this process was the DS-SIMO commitment of government and SAIC resources to proactively support the project and line managers in identifying the milestones and dependencies required for strategy definition and schedule baselining. Only rudimentary automated tools were used and then primarily for generating briefing aids. The real value added was the application of an informed and structural analysis process at the grass roots level to redefine the projects from a systems perspective.

## 1.5 Recommendation

Two primary conclusions were drawn from the experience of the last fifteen months. First, DS-SIMO should revalidate its fundamental assumptions, make the requisite adjustments and codify the new direction in terms of a concept of operations. Second, more progress toward institutionalizing the methodology is needed. SAIC recommends increasing the DS-SIMO proactive involvement in data collection and analysis as the best strategy to employ since that was the basis of its integration management successes and governed the most project, segment and line managers support.

# 2.0 INTRODUCTION

## 2.1 Purpose

This task documented requirements for an Integrated Scheduling System (ISS) to satisfy integration management, planning and scheduling responsibilities of DIA/DS. The ISS will be the primary tool used by the DS-SIMO as it focuses on interfaces, dependencies and integration among the projects and segments comprising the DIS.

Because of the need to ensure that the project management, technical design, fielding and integration of all DIS projects provide DIA the opportunity to optimize the use of assets in meeting mission requirements, DS-SIMO is charged with improving the accuracy and scope of information needed to support the system integration management function. SAIC worked closely with DS-SIMO and other DS staff elements to ensure the ISS requirements were focused on DIS integration management needs.

## 2.2 Background

Management of the DIS development process and post-deployment support of continuing operations is a complicated process. It involves interactive management and coordination among the users, the DIS segment managers, individual project managers and those charged with integration management on a daily basis (DS-SIMO).

Currently, DIS segment, project and integration managers use both manual and limited automated tools to manage the development and operational support projects within the DIS. Determining, coordinating and communicating current status to each other and to senior management within this environment is understandably hindered. Consequently, development and implementation of common terminology, definitions and standards within a structured integration management methodology has become imperative. Focusing on interfaces and project dependencies to facilitate communications and coordination among end users, developers and acquisition/procurement organizations is also imperative. The ISS provides the first step in implementing such a capability.

## 2.3 Scope

This effort was to aid DS-SIMO in identifying requirements and recommending alternatives for implementing an ISS within the DIA. This included:

a. Identifying DIS integration management requirements;

b. Collecting and analyzing data on designated DIS projects, their dependencies, and interfaces;

c. Developing a data base concept and structure focused on unique DIA requirements; and

d. Reviewing or analyzing government-owned and commercially available capabilities with respect to satisfying DIA requirements.

The results of subtasks a, b, and c above are documented in paragraphs 3.0 and 4.0 of this report and in the Software Requirements Specification (SRS) for the SIMOCODE Project which includes the supporting data base structure called SIMODATA. When validated by the government, these requirements will form the basis for a fully operational DIA-ISS capability. A by-product of this effort was a working prototype of dBase IV code (SIMOCODE) and its supporting data base structure (SIMODATA). SIMOCODE and SIMODATA were first employed in day-to-day support to DS-SIMO in July 1990.

The results of subtask d above are documented in paragraph 5.0 of this report.

## 2.4 Objectives

This task had two major objectives. The first was to apply SAIC's experience in integration management and in developing the Air Force Strategic Air Command Intelligence Data Handling Integration Management System and the Rome Air Development Center Project Management System to the projects and planned automation environment defined as the DIS and to synthesize functional requirements for an ISS for DS-SIMO. The second objective was to identify and document system requirements for an automated DIA-ISS.

# 3.0 DATA COLLECTION AND ANALYSIS

## 3.1 Methodology

### 3.1.1 Scope

SAIC conducted initial data collection and analysis activities for the 71 DIS projects identified from January 1990 through July 1990 for the purpose of establishing project and integration management baselines. Figure 3.1, DIS Segments, reflects the current projects constituting the DIS. The long term goal is to establish comprehensive baselines defined by cost, schedule, technical performance, interfaces and dependency parameters. However, the short term focus was on schedules and dependencies with cost, technical performance and interface parameters limited to specific cases when the data was readily available or critical to the integration of the project within the DIS. Recurring data collection and analysis continued through the end of the contract period for the purpose of baseline maintenance and integrity. A variety of techniques were employed for the data collection effort ranging from interviews with each project manager to the review of documentation and participation in technical and management forums. The desktop analysis that followed focused on identifying technical interface and schedule dependency information and determining compliance with the DIS Architecture and DIA policy/directives. For four of these projects, short term, intensive integration management techniques were employed. Paragraph 3.2.5, Special-Interest Project Support, documents this specialized support.

### 3.1.2 Assumptions

SAIC assumed that:

a. Segment managers would play a proactive role in DIS integration management. They would provide, at a minimum, a first level integration "reasonableness" check on project and interdependency data being forwarded to DS-SIMO for their segment.

# DIA Information System Segments
## Functional View

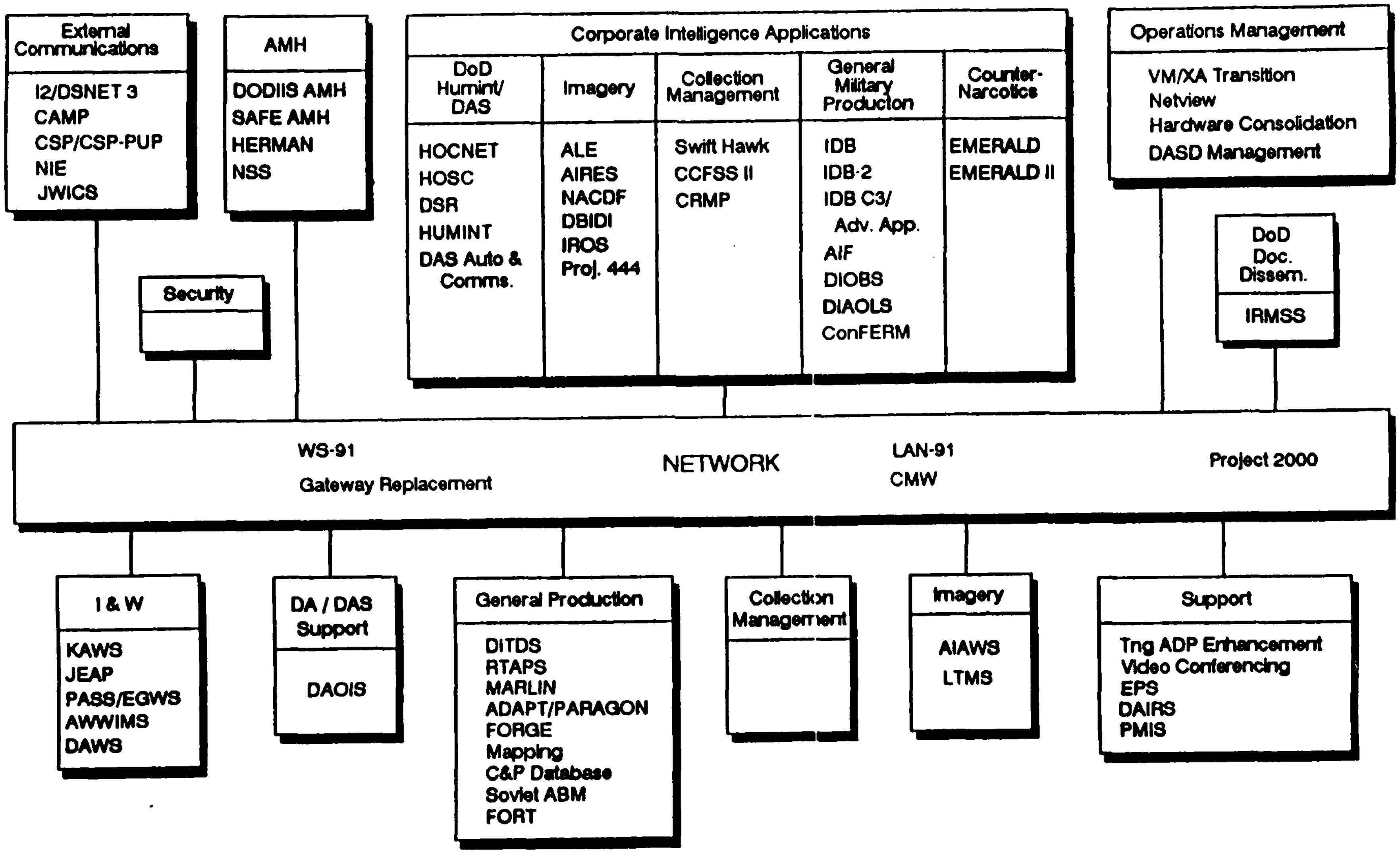



FIGURE 3.1 - DIS SEGMENTS

b. DIS projects had designated DIS project managers that were knowledgeable of, or practiced in, basic project management disciplines i.e., managing to cost, schedule and technical performance baselines, and consequently, could provide the data to be collected.

c. Consistent with the DS-SIMO operational and management philosophy of "push data collection," data would be forthcoming from the project, segment and line managers on a recurring basis once the initial baseline was established. Thus minimal DS-SIMO and SAIC effort would be expended for insuring data currency.

d. The government would complete most of the project related data collection with SAIC effort focused primarily on data analysis.

### 3.1.3 Constraints

Adhering to the DIA/DS policy that automated support tools must be on the DIA list of supported products coupled with a DS-SIMO decision to use the dBase III+ DBMS and Project Workbench software as the project management application significantly impacted productivity for the first six months. The capability to generate automated data collection and dependency analysis reports were foregone until SAIC had redeveloped the capability in dBase.

## 3.2 Findings

### 3.2.1 DIS Data Collection

#### 3.2.1.1 Initial Data Collection

SAIC initially used a set of standard project milestone, dependency and interface data collection forms developed by DS-SIMO for this activity. These forms (Attachment 1) worked very well for collecting data from the few well established projects under contractor development. However, for the remainder of the projects these standard forms inhibited communication and subsequently saw limited use as a prompting vehicle supporting an open interview process for general data gathering. A "twenty-questions" technique was employed for focusing attention on critical project milestones and

identifying schedule dependencies. Some raw data was obtained from the review of project or program management plans, workplans, schedules, specifications, interface documents, top level architectures and test plans, however, data captured from these sources were generally a by-product of SAIC's analysis effort as opposed to raw data collection.

Once the data points were verified, Project Workbench files were populated. They provided a rudimentary capability to support future data collection, dependency analysis, plus requirements synthesis and data base design. Using these methods, the SAIC and government team completed the initial data collection in July 1990 at which time schedule and dependency baselines were established for all DIS projects. Figure 3.2 depicts the completed Segment Baselining Schedule which drove the initial data collection effort.

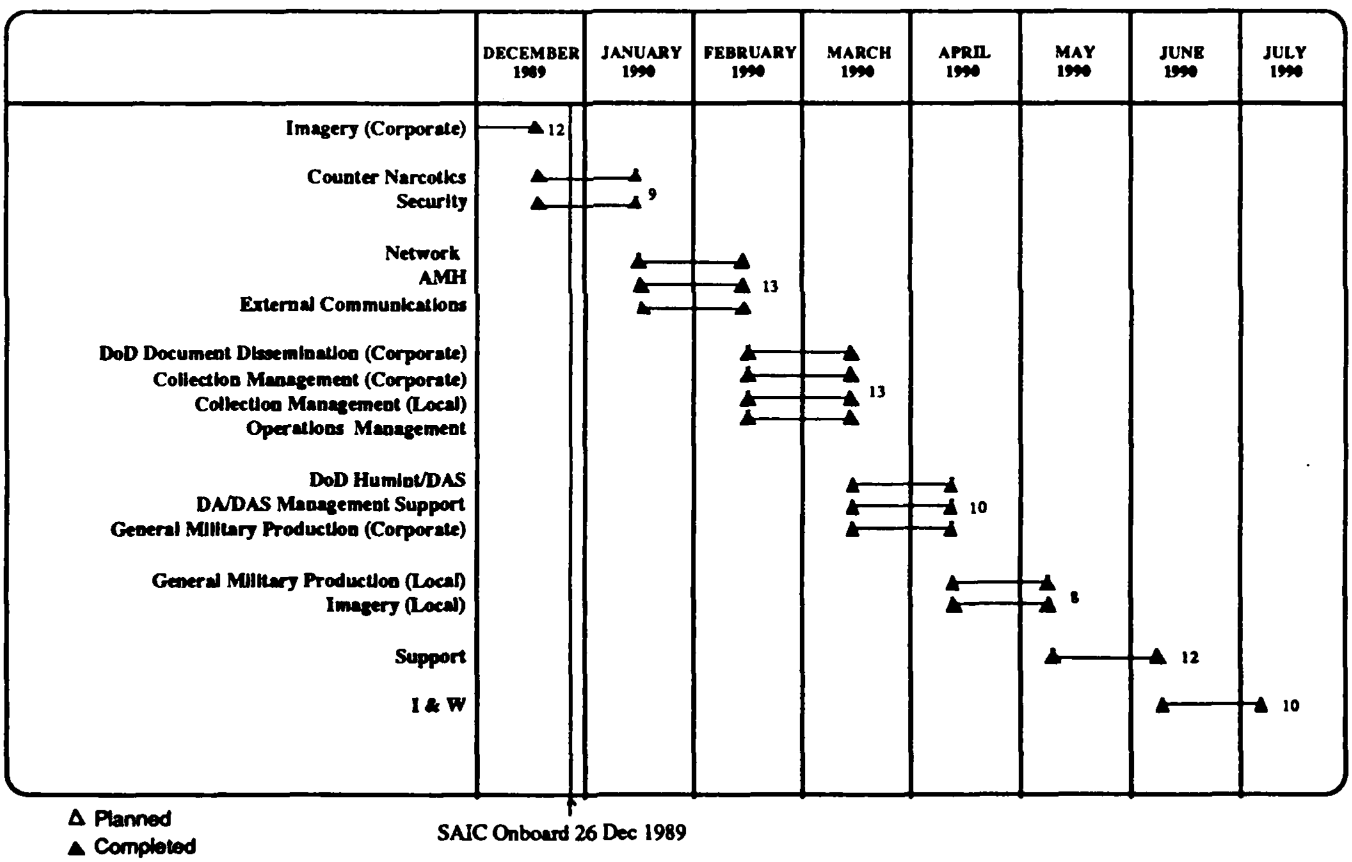



FIGURE 3.2 - SEGMENT BASELINING SCHEDULE

### 3.2.1.2 Recurring Data Collection

Concomitant with the initial data collection effort was the additive support to the growing data maintenance task for previously baselined projects. The scope of this support was completely underestimated by the government because the project, segment and line managers did not embrace the "push data collection" philosophy as expected. Consequently additional recurring data collection initiatives were required to maintain data currency and integrity. These initiatives included

a. Generating formal staff tasking for the data required,

b. Scheduling additional interview sessions,

c. Providing tutorial briefings to encourage more active participation, and

d. Proactive data collection and analysis of DIS projects distributed by segment across the total DS-SIMO (government and SAIC) staff.

Only the last initiative provided significant and consistent results (40% return per hours expended), whereas the remainder provided approximately a 15% return per hours expended. Under the distributed concept, SAIC assured care and feeding of four segments comprised of fifteen DIS projects.

One of the early tools used to enhance recurring data collection efforts was a milestone schedule generated from the Project Workbench data base. In May 1990, SAIC's data base design under dBase III+ (subsequently updated to dBase IV) progressed to the point that it could better support recurring data needs than could continued use of Project Workbench. Consequently, a single integrated data base of 700 milestones and 70 dependency relationships was generated in dBase III+. The milestones and dependencies were manually verified, reconciled with the Freelance graphic representations, coded for dBase data entry, manually keyed, and reverified for proper entry in dBase. Subsequently, SAIC generated dBase milestone schedules and dependency reports to prompt recurring data collection. Collectively, these reports identify every milestone, dependency and independency in the data base and provide a relatively easy mechanism for soliciting data base updates. SAIC suggested this method be employed since very few project/segment

managers were forwarding data base changes for their respective projects and the data base was losing currency. These reports (on-line and off-line) remain a primary means for communicating data collection needs to project, segment and line managers. Samples of these reports are at Attachment 2.

3.2.1.3 Cost/Resource Data Collection Strategy

3.2.1.3.1 Initiation

SAIC developed an initial cost data collection strategy consistent with the integration management requirements analysis (Paragraph 4.0) and DS-SIMO near term goals, and prepared the briefing given by DS-SIMO at the 12 June 1990 SIMO Segment Review kicking off the data collection effort. The short term strategy focused only on the execution phase of the resource life cycle with the following expected benefits:

a. Assure Project and DIS Master Schedule stability,

b. Minimize interproject impacts,

c. Identify candidate projects for resource reallocation, and

d. Optimize contract and government resources.

3.2.1.3.2 Data Sources

Multiple sources of data were recognized. Contract officers technical representatives (COTR) had access to contract resource data. Project managers generally had access to contract resource data for government technical and management resources which were dedicated to specific projects. This data was relatively easy to capture. The most difficult to identify and therefore capture were the government technical and management resources not dedicated to one specific project but matrixed across many.

#### 3.2.1.3.3 DS-SIMO Role

The DS-SIMO role was two pronged. Initially, DS-SIMO would task Segment and Matrix managers via memoranda requesting two levels of cost and resource data. They were

a. Planned versus actual contract costs, and

b. Identification of key government people so that task loading could be managed in the matrix environment.

Once the data was received, DS-SIMO would add value by assisting the respective managers establish realistic cost/resource baselines, by helping to manage the baselines as configuration management items under DS Configuration Control Board (DS-CCB) auspices, and by assisting in cost rebaselining as required.

#### 3.2.1.3.4 Project, Segment, and Matrix Manager Roles

The Project, Segment and Matrix Managers' roles in this strategy were to

a. Determine cost and resource baseline requirements and then budget and allocate resources to meet the requirement,

b. Establish the realistic cost baselines necessary to successfully execute the project by identifying cost, technical and schedule adjustments to be applied to the current baselines, and

c. Manage to the newly adjusted cost baseline by measuring and reporting actual resources expended against the baseline.

### 3.2.2 DIS Data Analysis

Whereas data collection activities varied with respect to initial or recurring collection, data analysis activities remained relatively constant recognizing, however, that certain projects warranted more scrutiny than others. Drawing from experience gained from the Strategic Air Command and the Rome Air Development Center efforts, SAIC decomposed projects to their lowest supporting functional activities and identified critical project milestones and interproject dependencies using the templates in Figures 3.3 and 3.4.

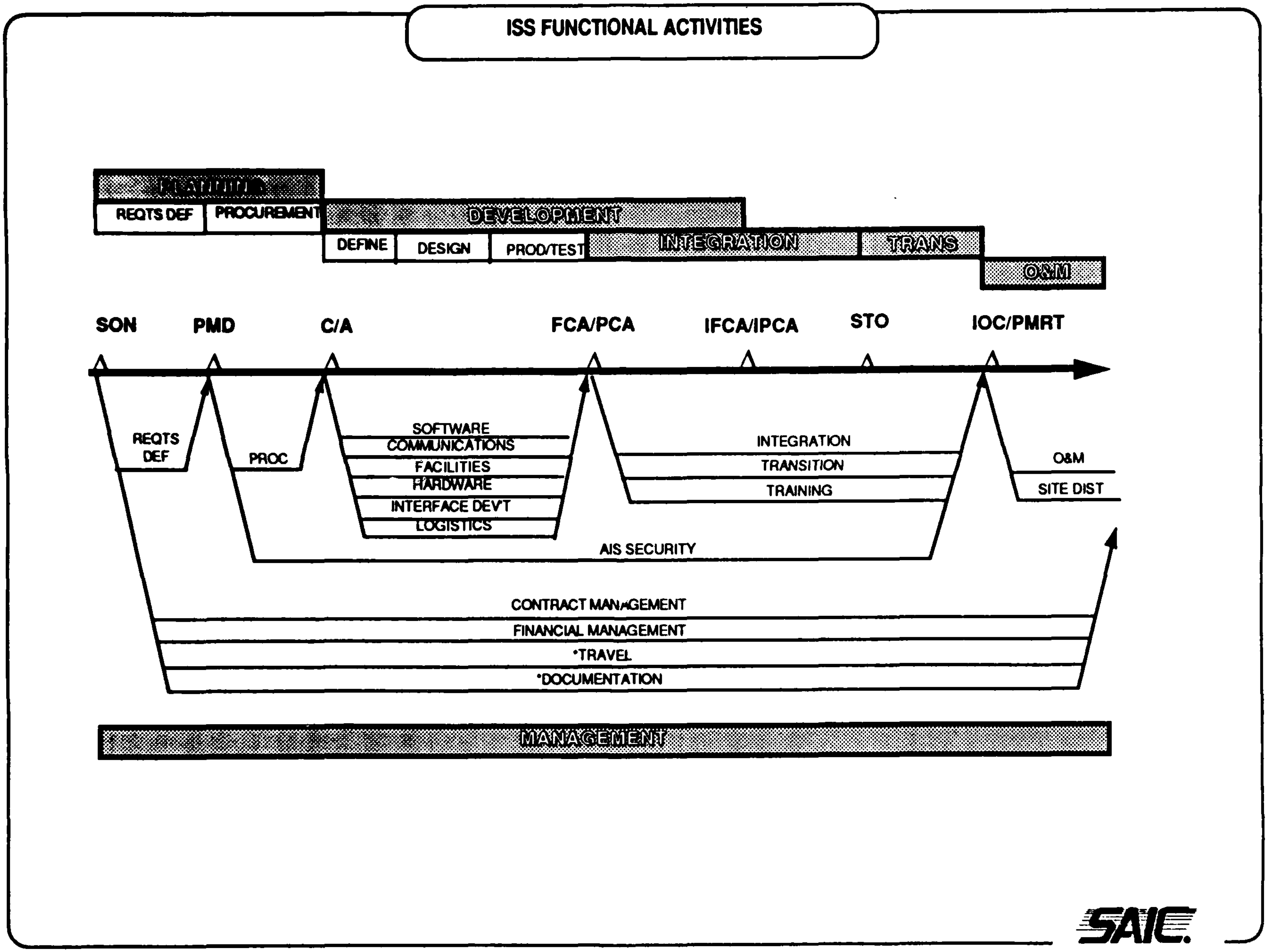



FIGURE 3.3 - ISS FUNCTIONAL ACTIVITIES

## ISS SYSTEM MILESTONES

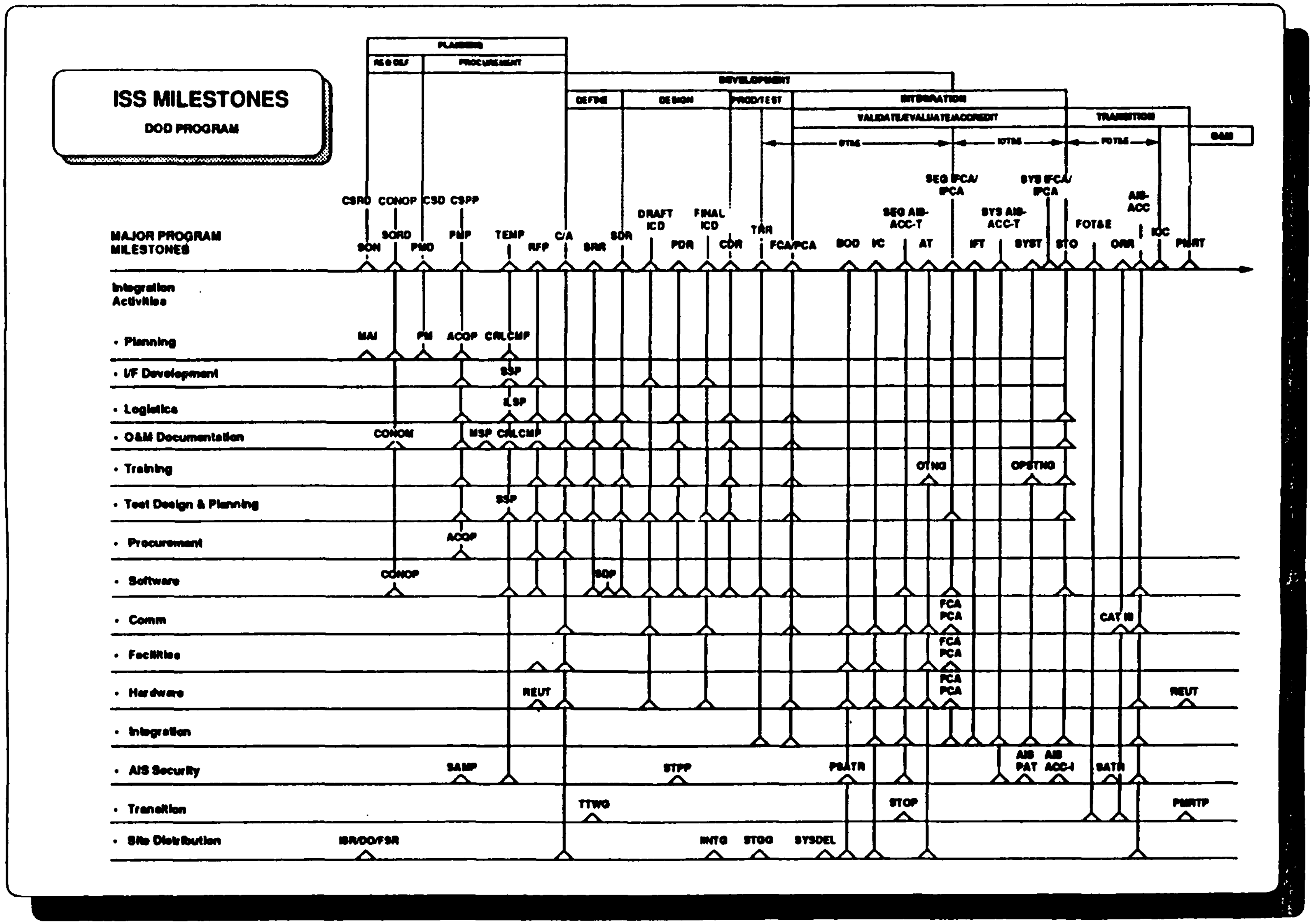



FIGURE 3.4 - ISS SYSTEM MILESTONES

Armed with this project level data and knowledge of the many standard milestones having inherent intra and interproject dependencies, SAIC analyzed this aggregate of information with respect to each project's operating environment to identify additional DIS dependency information not readily apparent to the project managers. In addition, any deviations from the DIS Architecture were identified for further analysis or adjudication. The depth of the analysis provided was directly proportional to the level of project risk and management interest, with the four special-interest projects receiving the most comprehensive analysis and enjoying the most stable schedules.

Regardless of the depth of analysis applied to a given project, every project received a vertical or self-analysis to determine its health with respect to meeting cost, schedule, and technical performance requirements. Then every project was analyzed with respect to interfaces and interproject dependencies to determine its health from a DIS or system integration perspective.

Initially, the Gantt charting and critical path analysis capabilities of Project Workbench were attempted but were not well suited to event or milestone driven analysis. Consequently, SAIC relied on normal analysis techniques prior to the dBase implementation.

### 3.2.3 DIS Schedules

#### 3.2.3.1 Structure

SAIC used the Lotus Freelance Plus Release 3.01 graphics capability to generate schedules of the project milestone and dependency data collected, analyzed and resident in the data base. Approximately 30 charts were revised on a monthly or as-required basis to reflect fact-of-life and anticipated changes to the approved schedule baselines. All were produced according to the hierarchical relationship depicted in Figure 3.5 and are a key component of the DS System Integration Notebook.

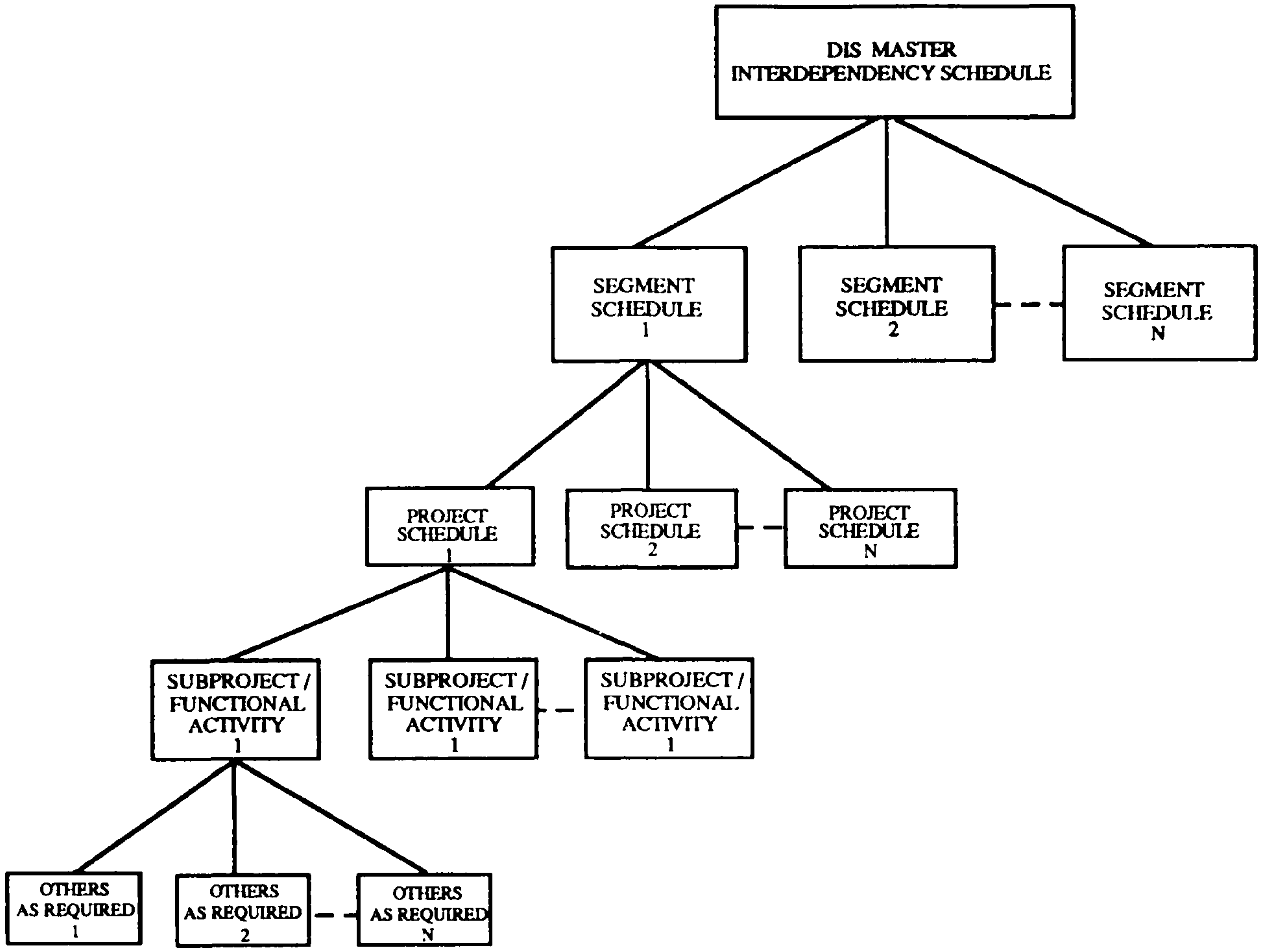



FIGURE 3.5 - DIS SCHEDULE HIERARCHY

Though currently a labor intensive process, thorough dependency analysis is significantly impacted without graphic representation of the data. Graphic representation also supports quality assurance since a data error is much more likely to be recognized graphically than by textual review alone. A synergy of analysis and data point quality assurance (QA) is also realized. Experience over this period of performance shows a considerable synergy between analysis and QA when the analyst knowledgeable about the data and its context within a project and the DIS generates and updates the respective schedules.

#### 3.2.3.2 DIS Master Schedules

At the top, the DIS Master Interdependency Schedule collates all interproject dependencies identified throughout the DIS into a system view. In order to accommodate the potential number of dependencies, the DIS Project Interdependency Schedule portrays only project-to-project dependencies. It is complemented by the DIS Government Furnished Equipment/Information (GFE/GFI) Interdependency Schedule portraying all dependencies between government organizations (DIA or external) and DIS projects. This breakout also focuses attention on whether a project manager or line manager is responsible for completing a dependent milestone. The first schedules were produced in February 1990 and have been updated on a monthly and as-required basis.

#### 3.2.3.3 Segment Schedules

The next subordinate level, the Segment Schedule, collates into a segment view the key milestones, intra-segment dependencies and all interproject dependencies for its functional projects. The initial Segment Schedules were generated according to the Segment Baseline Schedule (Figure 3.2 page 10). All dependencies among functional projects are displayed within a white band across the center of the chart. Interproject dependencies external to the segment are identified by project or GFI labels and displayed in shaded bands at the top and bottom of the chart. Currently 17 Segment Schedules composed of 71 projects are being updated on a monthly and as-required basis.

#### 3.2.3.4 Project Schedules

The Project Schedule provides the next level of detail and has been generated only for special-interest projects, i.e., CAMP, DIAOLS Termination and VM/XA Implementation. A single format has been used but with tailored headings. When focusing on the external or interproject dependencies, the project column lists other projects for which dependencies are displayed. When including internal or intraproject dependencies, the project column (now labeled Project/Subproject) also lists subordinate project tasks for which dependencies are displayed.

### 3.2.3.5 Subproject Schedule

The Subproject or Functional Activity Schedule extends the flexibility of this graphic format another level. The subproject represented by a single line on a Project schedule is now further decomposed into its constituents.

### 3.2.3.6 Examples

This format supports any level of schedule portrayal. The levels of depth of data collection and analysis and subsequent graphical representation by this format are strictly dependent on the level of decomposition and detail required to manage the specific integration problem. Current examples of these schedules can be obtained from DIA/DS-SIMO.

## 3.2.4 Status Assessments Reports

### 3.2.4.1 Structure

Fundamental to the Integration Management Requirements Analysis (paragraph 4.0) is the concept of system/segment/project assessment by an independent source, in this case, DS-SIMO. To support such a requirement, a series of status assessment reports were developed using Lotus Freelance Plus Release 3.01. Each is produced according to the hierarchical relationship depicted in Figure 3.6 and corresponds to the schedule hierarchy in Figure 3.4. The reports are designed to quickly focus management attention on projects/segments/organizations having internal difficulty and more importantly, the potential to impact others. The requisite management attention could be at the project, segment, line or corporate level. These reports are also a key component of the DS System Integration Notebook.

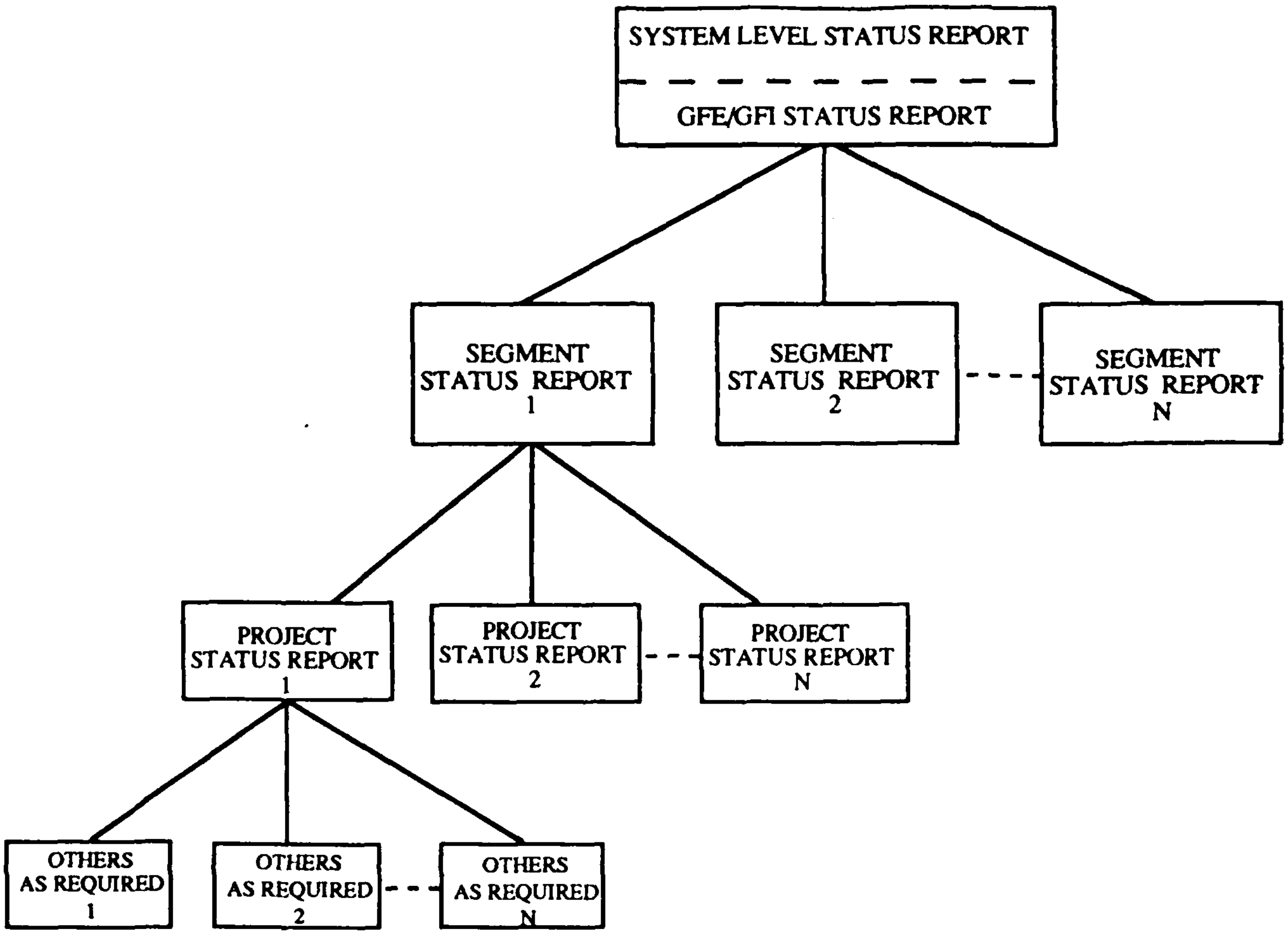



FIGURE 3.6 - DIS STATUS REPORT HIERARCHY

### 3.2.4.2 System Level and GFE/GFI Status Reports

At the top, the System Level Status Report and GFE/GFI Status Report reflect the assessed status of the DIS as depicted in the DIS Project Interdependency Schedule and the GFE/GFI Interdependency Schedule respectively. These reports present DS-SIMO's assessment of the health and welfare of each of five attributes for each segment in the DIS. The cost, schedule and technical attributes reflect the collective assessed status of a segment's projects, whereas the interface and dependency attributes reflect the collective assessed status of the segment as its projects relate to other projects and segments. Each attribute is assessed as being Satisfactory, Marginal, Unsatisfactory or Not Baselined and are color-coded as Green, Yellow, Red and White respectively. Narrative justification/comments are required for each instance of a Marginal and Unsatisfactory assessment.

### 3.2.4.3 Segment Status Charts

The Segment Status Charts reflect the assessed status of the segments depicted in the respective Segment Schedules. The reports present DS-SIMO's assessment of the health and welfare of each of five attributes for all projects in the segment. The cost, schedule and technical attributes reflect the assessed status of each functional project, whereas the interface and dependency attributes reflect the assessed status of each functional project as it relates to other projects. Attribute assessment and narrative justification are analogous to those for the System Level Report.

### 3.2.4.3 Examples

This format can be used to portray the assessed status at any level chosen but generally corresponds to its respective schedule. Current examples of these charts can be obtained from DIA/DS-SIMO.

### 3.2.5 Special-Interest Project Support

SAIC intensively applied integration management techniques to four special-interest projects. The projects are CAMP, NSS Termination, DIAOLS Termination and VM/XA Implementation. Though all were DIS baselined projects, each drew focused DIA/DS attention due to schedule, dependency, cost and contractual risk if those projects did not meet transition schedules. The techniques applied were the same techniques applied to the remainder of the DIS projects, only the emphasis changed.

For those four projects, the emphasis was on transitioning into or out of operational status. Therefore, it was necessary to change the focus from being project oriented to becoming system oriented. Consequently, each project was restructured into defacto "Transition Increments" as defined in SAIC's Information Systems Integration methodology and documented during the Integration Management Requirements Analysis (paragraph 4.2.1) as a requirement for DS-SIMO implementation. It was this restructuring of the transitioning project into a DIS view that changed the thought process and enabled the final results.

After analysis of the data collected for NSS Termination and CAMP, each project was further decomposed to establish its base intraproject dependency

set. From this more detailed data, additional interproject dependencies and a more realistic schedule was generated.

For the DIAOLS Termination Project, SAIC helped prepare the data collection strategy, analyze data collected, structure a decision briefing, and work the post-briefing actions. A comprehensive and achievable schedule of milestones and dependencies defining a cost-effective termination strategy while preserving user support resulted.

For the VM/XA Implementation project, SAIC helped analyze implementation requirements, identified and deconflicted dependencies, and developed an integrated schedule to include VM/XA subproject tasks for accomplishing the implementation strategy.

The results of these four projects testify to the necessity of integration management in a complex environment. When applied with diligence and accountability, it is invaluable in properly scoping the problem, focusing effort on risk areas, eliminating surprises, and producing the results that senior management likes.

### 3.2.6 Problems Encountered

#### 3.2.6.1 General

Generally, data collection and analysis shortfalls were predictable in type but significantly greater in scope than expected. Data base currency continues to average 30 to 60 days behind calendar date. Contributors to this situation are

a. The lack of feedback on scheduled events by project and segment managers,

b. Project managers not planning future milestones and dependencies for their projects, and

c. Ambiguous, inconsistent and uncoordinated updates when provided.

The effects of this over the longer term are numerous and significant if not checked. First, the data base quickly reduces to a historical repository, instead of an active integration management tool. Second, extraordinary data

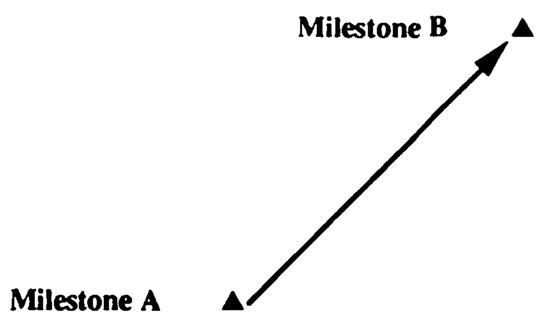
collection efforts are required of DS-SIMO and/or line managers to recover. In some instances this requires total project rebaselining. Third, analysis time and resources tend to grow exponentially in an effort to make existing data consistent, clear and useful to management. Unfortunately this contributes to the data currency problem. Fourth, continued use of the data base as an integration management tool by managers at all levels is directly proportional to the confidence in the data.

#### 3.2.6.2 Dependency Control Document (DCD)/Dependency Reporting

The difficulty in understanding the concept of a schedule dependency and confusion with interfaces was unexpected and is still evident. Simply stated, a dependency is a schedule relationship that exists when one event or milestone cannot occur or be completed until preceded by the completion of another event or milestone. If these relationships are wholly within a project they are called intraproject dependencies. Figure 3.7 illustrates an intraproject dependency.

**Intraproject Dependency Definition**

- **Definition of Intraproject Dependency: relying on another for support**




- **Milestone B relies on Milestone A to deliver some sort of support**

**Milestone B is the Dependent Milestone**

**Milestone A is the Independent Milestone**

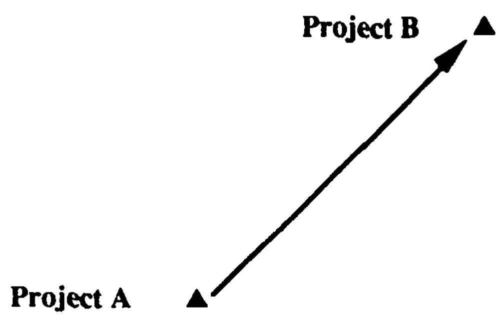
FIGURE 3.7 - INTRAPROJECT DEPENDENCY DEFINITION

If dependency relationships exist between or among projects they are called interproject dependencies and are the main focus of integration management

by DS-SIMO. A more detailed discussion of dependencies is documented in the "Software Requirements Specification for the SIMOCODE Project" produced for DIA/DS-SIMO. Figure 3.8 illustrates an interproject dependency.

**Interproject Dependency Definition**

- **Definition of Interproject Dependency: relying on another for support**




- **Project B relies on Project A to deliver some sort of support**

**Project B is the Dependent Project**

**Project A is the Independent Project**

FIGURE 3.8 - INTERPROJECT DEPENDENCY DEFINITION

Because of the difficulty encountered with segment and project managers identifying and coordinating valid dependencies, SAIC recommended and DS-SIMO implemented the DCD strategy as a solution. The DCD (Figure 3.9) is intended to do for an interproject dependency what an Interface Control Document does for project interfaces, i.e., unambiguously document the dependent relationship between two different projects--one the dependent (or needing/requiring) project and the other the independent (or owing/supplying) project.

| **Dependency Control Document** | **DCD #:**<br>**Date Tasked:**<br>**Date Received:** |
|---|---|

| | |
|---|---|
| **Dependent Project:**<br>**Dependent Milestone:**<br>**Dependent Milestone Data:**<br><br>**Description of Items required at Dependent Milestone:** | |
| **Project Manager Name:**<br>**Project Manager Signature:** | **Date Signed:** |
| **Independent Project:**<br>**Independent Milestone:**<br>**Independent Milestone Date:**<br><br>**Description of Items to be provided at Independent Milestone:** | |
| **Project Manager Name:**<br>**Project Manager Signature:** | **Date Signed:** |

**FIGURE 3.9 - DEPENDENCY CONTROL DOCUMENT**

It documents an agreement or defacto contract between two project managers based upon the mutual understanding of the scheduled requirement and serves as a concrete basis for renegotiation should a change in either project's schedule or deliverable impact the dependency.

SAIC initiated the effort by briefing the strategy at the June 12, 1990 SIMO Segment Review. The DCD was subsequently included in the AIS Project Managers Handbook which requires its use for documenting interproject dependencies. Where the DCD was faithfully used by project managers, the strategy has been proven. However, success has yet to be achieved. The day-to-day benefits of the DCD have not been recognized by project, segment, nor line managers and consequently has not been institutionalized within the DIS. SAIC continues to believe that the DCD is critical to interproject dependency management within the DIS.

#### 3.2.6.3 Cost/Resource Data Collection and Analysis

Only scattered response was achieved by the cost/resource data collection effort. Repeated data calls provided insignificant results. Consequently, no analysis of cost/resource data was performed.

### 3.3 Assessment and Recommendations

The data collection and analysis experience showed that the "push data collection philosophy" doesn't work unless managers perceive the exercise as mutually beneficial (not just another senior management exercise in micro-management), and the collection process is a byproduct of their daily routine as opposed to an added requirement.

In the cases of the special-interest projects, data collection and analysis became mutually supportive of DS-SIMO and the respective project managers, but data was not automatically forwarded to DS-SIMO to support data base update requirements. Generally, a more proactive approach was required of the DS-SIMO staff if real benefits were to be attained. This was especially so for the recurring data collection requirements across the DIS.

The recurring data collection experience also suggested that all projects do not require the same level of attention, especially the local AISs. Consequently, DS-SIMO should consider employing a two tiered approach for recurring data collection and analysis. Priority projects could constitute one tier and require

proactive attention while second tier projects could continue on a "push data collection" basis. Such an approach requires acceptance of less current schedules for second tier projects. The benefit, of course, is freeing the limited DS-SIMO staff to focus on the more critical integration management needs.

Project data volatility strongly suggested that many projects were not properly defined and that many efforts assigned to the "infrastructure" could profit by a project-orientation. No resources need to necessarily be reassigned but visibility, scope and accountability readjusted. Projects tend to focus on endpoints and goals with accountability leading to more disciplined management. On the other hand, infrastructure activity tends to focus on the process which subsumes the original goals. SAIC found that the largest set of dependencies, those for which it was the hardest to determine responsibility, and those most likely to miss their scheduled milestones, were also those emanating from the DS infrastructure.

# 4.0 INTEGRATION MANAGEMENT REQUIREMENTS ANALYSIS

## 4.1 Methodology

### 4.1.1 Scope

SAIC conducted an Integration Management Requirements Analysis from January 1990 through May 1990. During this analysis, SAIC applied the the Project Management Dynamics Model and System Integration Dynamics Model (Attachment 3) to define and bound the scope of the DS-SIMO integration management effort. This analysis was done in a "story board" format to allow a highly interactive process between SAIC and DS-SIMO with rapid turnaround. The final result of this process was documented separately and can be obtained from DIA/DS-SIMO.

### 4.1.2 Analysis

The analysis resulted in a set of charts depicting the types of reports an integration management system would have to produce to meet the DS-SIMO mission. These reports would be primarily on-line reports with an analyst option to print a hard copy. On sign-on, a system user would be advised of his open action items and be given a menu from which to work. The open action item reports would list those action items for which the person signing on, an entire segment, or a project was responsible.

The system level status report was designed to provide, in one chart, a comprehensive status of all the segments and integration management areas for the DIS. The segment level status report showed similar data for the projects in a segment while the project status report focused on one project.

As part of helping DS-SIMO define a configuration management process, the Baseline Change Request (BCR) Summary chart would collect BCR's at the segment level and at the project level. Separate reports provide details on the five areas (Cost, Schedule, Technical, Interfaces, and Dependencies) evaluated for each project.

### 4.1.3 Priorities and Constraints

DS-SIMO itself was limited in the resources it could apply to this task and, therefore, established priorities for developing the system design to meet the

identified requirements. The first priorities were to develop the schedule and dependency reports and supporting data base. That data base was to have a structure to allow adding, cost, technical, and interfaces, action items, and BCR's at a later date. SAIC estimated, and DS-SIMO concurred, that only schedule and dependency tracking could be completed within the time and resources allocated to this effort. The prototype SIMOCODE and SIMODATA were the end products of this work.

## 4.2 Assessment

The prototype SIMOCODE demonstrated its utility for tracking milestones and dependencies throughout the DIS and particularly for the four special interest projects cited in paragraph 1.2.1. It also focused attention on the need to plan for transition increments (part of the System Integration Dynamics Model), interfaces and technical performance.

As the DIS project managers began to see the value added by the DS-SIMO work and also obtained access to the DS LAN, the need for a SIMOCODE to support LAN access also grew. Plans to accomplish this objective were worked outside of this effort.

SIMOCODE's success at DS-SIMO brought SIMOCODE to the attention of the newly formed DODIIS-SIMO in November 1990 and SAIC advised the DODIIS-SIMO staff regarding the Project Management Dynamics Model and System Integration Dynamics Model and their application to the DODIIS-SIMO environment. The result was a joint DS-SIMO/DODIIS-SIMO evaluation briefed by SAIC which detailed the similarities between the two SIMO operations and outlined an approach for using SIMOCODE on the LAN to meet both organization's needs. The recommended approach consisted of two phases. Phase 1 was to convert SIMOCODE to LAN operation and evaluate SIMOCODE's utility on-line. This phase is underway as this report is being written. Phase 2 will use the on-line prototype to build the joint DS SIMO/DODIIS SIMO requirements and procedures and add functionality to the SIMOCODE. Contact DIA/DS-SIMO for the analysis of the two operations and a more detailed discussion of the approach for SIMOCODE to meet the needs of both organizations.

# 5.0 THE INTEGRATION MANAGEMENT SYSTEM ALTERNATIVES ANALYSIS REPORT

## 5.1 Methodology

### 5.1.1 Scope

SAIC conducted a functional and technical analysis of commercial, off-the-shelf (COTS) data base manager and project management software on a continuing basis. The analysis was based on the results of the DIA-ISS requirements identified by the Integration Management Requirements Analysis effort (Paragraph 4.0) and was consistent with the DIS Architecture, DIA Architecture Standards and Products, and DIA/DS policy. Once the product base was chosen, SAIC translated the functional requirements into a Software Requirements Specification and accompanying Data Base Design Document. These documents not only reflect the fully operational DIA-ISS requirement baseline but also document the working prototype delivered as a by-product of the requirements analysis effort.

### 5.1.2 Assumptions

a. SAIC assumed that the results of the December, 1989 undocumented DS-SIMO study of off-the-shelf project management software and data base management systems are valid and accepted Project Workbench and dBase III+ as the products of choice. However, non- duplicative analysis of these products would be conducted as changes to DS-SIMO requirements and COTS product lines occurred.

b. Since Data Item Descriptions (DIDs) were not specified, SAIC selected DI-MCCR-80025A, Software Requirements Specification (SRS), 29 Feb 1988, for documenting DIA-ISS requirements and the working SIMOCODE prototype.

### 5.1.3 Constraints

The alternatives analysis could only consider products approved for the DIA list of supported products.

### 5.2 Findings

### 5.2.1 Product Evaluation

### 5.2.1.1 Project Workbench

SAIC populated the Project Workbench data structure for use as a data repository and to support analysis plus the initial graphics generation for SIMO Segment Reviews. However, as the scope of the DS-SIMO mission, became clear and the DIA-ISS requirements matured, the limitations of Project Workbench began to surface. Chief among these were its

a. Inability to handle over 70 DIS projects simultaneously,
b. Inability to handle intricate dependency relationships within and among projects,
c. Inability to handle technical and interface data between projects,
d. Inadequate schedule chart formatting, and
e. Restrictive handling of cost data.

### 5.2.1.2 Project Management System

In 1989, SAIC delivered a prototype Integrated Scheduling System to the Rome Air Development Center, Air Force Intelligence Agency, and the Electronics Systems Division of the Air Force Systems Command. This system, entitled Project Management System (PMS), and patterned after the integration management system operational at Strategic Air Command, was developed using the Advanced Revelation (AREV) data base management system for IBM compatible platforms. While PMS could handle intricate dependencies and a large number of projects well, it did not address technical performance or interfaces nor did it adequately address cost when compared to DS-SIMO stated objectives. Schedule charts were produced two ways. Gantt portrayals were plotted directly from the data base while more intricate graphics were produced freehand using MacIntosh graphics capabilities. DS-SIMO did not support SAIC's recommendation to use the prototype PMS software for requirements synthesis and daily operations support interim to a DIA standard system becoming available. The use of AREV weighed heavily against PMS since AREV was not on the DIA list of supported data base management systems. (See paragraph 5.2.1.6 for a discussion of MacIntosh products.)

#### 5.2.1.3 Lotus Freelance Plus Version 3.01

Lotus Freelance is a DIA standard general graphics program for the IBM personal computer (PC) and compatibles. Frustrations with obtaining adequate schedule charts, led DS-SIMO to adopt Freelance, and considerable labor hours attendant to its use, as the method for producing acceptable schedule charts. Automatic generation of Freelance quality schedules may be available soon. In the April 1987 issue of the International Journal of Pattern Recognition and Artificial Intelligence, Freeman and Ahn's article, "On the Problem of Placing Names in a Geographic Map," describe an automatic technique for producing maps from a digital database where names are placed without conflict with other features. This problem is essentially the same as the schedule generation problem and may well be directly applicable.

#### 5.2.1.4 dBase III+ and dBase IV

dBase is a standard DIA data base manager. To provide a point of comparison between PMS/AREV and the data base design developed for this type of application, SAIC developed a set of dBase files and data to demonstrate the integration management data base concept. This concept was accepted and SAIC proceeded to develop the code further as DS-SIMO gained more experience. A dBase III+ limitation is its inability to write reports to a file. dBase IV has that ability and was selected to support report writing that would be distributed over the local area network (LAN).

#### 5.2.1.5 Forms Managers

dBase has a limited ability to create forms for reports or input. Off-the-shelf forms managers that interface directly with dBase files are available. A study of capabilities should show how one of these packages can be added to the SIMOCODE prototype to greatly enhance input and output of data. Conduct of this study is premature until the LAN capable SIMOCODE prototype has stabilized. Similarly, any forthcoming decision on a DIA-ISS final product/architecture other than SIMOCODE should also include Forms Manager evaluation criteria.

5.2.1.6 MacIntosh Products

The DIA standard personal computer is the IBM family of compatibles. This standard precluded considering applications directed at the MacIntosh architecture.

5.2.1.7 SYNERGY

SYNERGY is a modular project control system developed by the Bectel Corporation using the ORACLE data base management system (DBMS). It is comprised of 14 modules which are selectable by the project for its specific needs. The system can be run on personal computers as well as on mini computers and mainframes. Though literature research showed it to be a very comprehensive capability, DS-SIMO directed that no further investigation or analysis be undertaken for two reasons;

a. The DBMS is not on the DIA list of supported DBMSs, and

b. The system was judged cost prohibitive. Basic start-up modules are priced at $6500 plus an annual maintenance fee of $1300. Each additional module is priced at $2500 plus an annual maintenance fee of $500. Even with a significant price discount, SYNERGY would remain unaffordable.

5.2.1.8 SYBASE

SYBASE is a distributed, relational DBMS considered for the ALE project. DS-SIMO and SAIC attended a demonstration meeting in Rosslyn, Virginia to determine whether SYBASE could accommodate the DS-SIMO needs should ALE select SYBASE and DIA subsequently adopt SYBASE as a DIA standard.

We concluded that nothing in SYBASE precluded doing the dBase IV coded functions on this system as opposed to any other DBMS. In some respects, the ability to establish a distributed system may make the dBase IV coded system easier and more effective because the individual projects would have local control over their own portion of the data base.

#### 5.2.1.9 Clipper

Clipper is a dBase compatible system that allows for compiling the source code into execution modules that run very quickly and without the need for a run-time version of dBase. (Run time modules must be purchased.) Clipper should be used to compile, configuration manage, and distribute dBase IV code when the source code stabilizes.

#### 5.2.1.10 Others

As the DIA-ISS matures and becomes institutionalized, requirements tracing and accounting software will need to feed the DIA-ISS data base. When that time comes an analysis of COTS and government-owned software should be undertaken.

### 5.3 Assessment

Given the constraint of using products approved for the DIA list of supported products, the selection of dBase IV and Freelance on the IBM compatible platform should satisfy DIA-ISS automated requirements for the foreseeable future. Continued search for a COTS or government-owned product which integrates data base functions, analysis tools and graphics generation is certainly warranted. However, such a product will likely not be on the current DIA list of supported products. Regardless, caution is advised so that the sophistication of the chosen tools does not generate a learning curve and data loading requirement which far exceed the expected benefit.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

A number of conclusions are drawn which SAIC provides in prioritized order.

a. Recommend DS-SIMO revalidate its fundamental assumptions in light of the lessons learned over the past 15 months, make the requisite adjustments and codify that direction in a Concept of Operations.

b. In order to succeed in the long term, the methodology must be institutionalized, i.e., it must be accepted and supported by the project, segment and line managers. Since success tends to beget success, concentration on those activities which led to the integration management successes is logical. Consequently, more proactive involvement in data collection and analysis by DS-SIMO is recommended. Not only will this create additional short term successes, but it will reinforce the tenet that DS-SIMO is a positive force that can help bring about success.

c. Caution is recommended in the continued search for automation tools. Overly sophisticated tools, even if inexpensive and fully COTS, may carry a learning curve and data loading cost that may far exceed the expected benefit. Though not fancy nor fully integrated, the current data bases and graphics tools, with limited enhancement, could serve the DS-SIMO until such time that the data manipulation and presentation requirements are validated with respect to the Concept of Operations.

d. The System Integration Management Plan, AIS Project Managers Handbook, and Configuration Management Plan need to be baselined, published and distributed as soon as possible. Recommend however, that a progressive implementation strategy and supporting procedures be developed prior to distribution of the Configuration Management Plan. The DS-SIMO currently does not have the resources nor the procedures to support the full scope of the plan. Consequently, a "go-slow" approach consistent with DS-SIMO resource demands is encouraged.

e. DS-SIMO Segment Reviews have been the most effective when focused on DIS integration problem solving. In keeping with the "success begets success" theme, issues which do not meet this criteria should not be addressed in this forum. They take an inordinate amount of time, rarely come to concrete resolution, and have a long term deleterious effect on participation in the reviews.

f. The commitment of staff resources to work with the DODIIS-SIMO is recommended to ensure that the respective functional and system requirements are as convergent and mutually supportive as possible.

ATTACHMENT 1

Data Collection Forms

This attachment contains a set of standard project milestone, dependency and interface data collection forms initially used for the DIA-ISS effort.

# PROJECT MILESTONE REPORT

PROJECT TITLE__________ PROJECT MANAGER__________ DATA COLLECTION DATE__________

ORGANIZATION__________ SIMQ DATA COLLECTOR__________ BASELINE DATE__________

| ACTIVITY | GOVT/CONT | DELIVERABLE/COMMENT | Planned Start Date | Planned End Date | Revised Start Date | Revised End Date | Actual Start Date | Actual End Date | Percent Complete |
|---|---|---|---|---|---|---|---|---|---|
| Project Mgt. Plan | | | / / | / / | / / | / / | / / | / / | |
| CM Plan | | | / / | / / | / / | / / | / / | / / | |
| QA Plan | | | / / | / / | / / | / / | / / | / / | |
| Interproject Dependencies | | | / / | / / | / / | / / | / / | / / | |
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| | | | | | | | | | |
| Contract Process | | | | | | | | | |
| 520 | | | / / | / / | / / | / / | / / | / / | |
| RFP | | | / / | / / | / / | / / | / / | / / | |
| Evaluation/ Negotiation | | | / / | / / | / / | / / | / / | / / | |
| Contract Award | | | / / | / / | / / | / / | / / | / / | |
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ISSUES/CONCERNS: __________

# PROJECT MILESTONE REPORT

PROJECT TITLE__________ PROJECT MANAGER__________ DATA COLLECTION DATE__________
ORGANIZATION__________ SIMO DATA COLLECTOR__________ BASELINE DATE__________

| ACTIVITY | GOVT/CONT | DELIVERABLE/COMMENT | Planned Start Date | Planned End Date | Revised Start Date | Revised End Date | Actual Start Date | Actual End Date | Percent Complete |
|---|---|---|---|---|---|---|---|---|---|
| Requirements Process | | | | | | | | | |
| Functional Requirements | | | / / | / / | / / | / / | / / | / / | |
| CONOPS | | | / / | / / | / / | / / | / / | / / | |
| System Requirements | | | / / | / / | / / | / / | / / | / / | |
| Review/ Approval | | | / / | / / | / / | / / | / / | / / | |
| Software Requirements | | | / / | / / | / / | / / | / / | / / | |
| Review/ Approval | | | / / | / / | / / | / / | / / | / / | |
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| Preliminary Design | | | | | | | | | |
| Top Level Design | | | / / | / / | / / | / / | / / | / / | |
| Review/ Approval | | | / / | / / | / / | / / | / / | / / | |
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ISSUES/CONCERNS:

# PROJECT MILESTONE REPORT

PROJECT TITLE______________ PROJECT MANAGER______________ DATA COLLECTION DATE__________

ORGANIZATION______________ SIMO DATA COLLECTOR______________ BASELINE DATE__________

| ACTIVITY | GOVT/CONT | DELIVERABLE/COMMENT | Planned Start Date | Planned End Date | Revised Start Date | Revised End Date | Actual Start Date | Actual End Date | Percent Complete |
|---|---|---|---|---|---|---|---|---|---|
| Interface Definition | | | | | | | | | |
| Draft ICD | | | / / | / / | / / | / / | / / | / / | |
| Final ICD | | | / / | / / | / / | / / | / / | / / | |
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| Detailed Design | | | | | | | | | |
| Detailed Design | | | / / | / / | / / | / / | / / | / / | |
| Review/ Approval | | | / / | / / | / / | / / | / / | / / | |
| | | | | | | | | | |
| Logistics Support | | | | | | | | | |
| Training Plan | | | / / | / / | / / | / / | / / | / / | |
| Development Facility | | | / / | / / | / / | / / | / / | / / | |
| Security Accredit. Plan | | | / / | / / | / / | / / | / / | / / | |
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# PROJECT MILESTONE REPORT

PROJECT TITLE__________ PROJECT MANAGER__________ DATA COLLECTION DATE__________

ORGANIZATION__________ SIMO DATA COLLECTOR__________ BASELINE DATE__________

| ACTIVITY | GOVT/CONT | DELIVERABLE/COMMENT | Planned Start Date | Planned End Date | Revised Start Date | Revised End Date | Actual Start Date | Actual End Date | Percent Complete |
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| Testing | | | | | | | | | |
| Test Readiness Review | | | / / | / / | / / | / / | / / | / / | |
| Integration Testing | | | / / | / / | / / | / / | / / | / / | |
| Independent System Test | | | / / | / / | / / | / / | / / | / / | |
| User Accept. Test | | | / / | / / | / / | / / | / / | / / | |
| | | | | | | | | | |
| Transition/ Turnover | | | | | | | | | |
| Transition Plan | | | / / | / / | / / | / / | / / | / / | |
| Version Descrip Document | | | / / | / / | / / | / / | / / | / / | |
| User Manual | | | / / | / / | / / | / / | / / | / / | |
| Operators Manual | | | / / | / / | / / | / / | / / | / / | |
| Programmer's Manual | | | / / | / / | / / | / / | / / | / / | |
| IOC | | | / / | / / | / / | / / | / / | / / | |

ISSUES/CONCERNS:

# PROJECT MILESTONE REPORT

PROJECT TITLE____________ PROJECT MANAGER____________ DATA COLLECTION DATE____________

ORGANIZATION____________ SIMO DATA COLLECTOR____________ BASELINE DATE____________

| ACTIVITY | GOVT/CONT | DELIVERABLE/COMMENT | Planned Start Date | Planned End Date | Revised Start Date | Revised End Date | Actual Start Date | Actual End Date | Percent Complete |
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ISSUES/CONCERNS: ____________

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# DEPENDENCY REPORT

AS OF ________

| Project | Dependency | Type | Planned Date | Required Date | Status | Comments |
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**Type**

I=Data/Communications Interface
D=Deliverable
G=GFE/GFI
X=External DIA Dependency
F=Facility Requirement

**Status**

Red
Yellow
Green

# INTERFACE REPORT

PROJECT TITLE________________ PROJECT MANAGER______________ ORGANIZATION______________ AS OF_____

| System A | I/F Direction | System B | OPR | Interface Type | Interface State | Interface Medium | ICD ID / Date | ICD Status | Doc. Phase | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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## LEGEND

**Interface Direction**
- → From A to B
- ← From B to A
- ↔ Bidirectional

**Interface Type**
- C=Communications
- D=Data
- I=Internal DIA
- E=External DIA

**I/F State**
- E=Existing
- Pl=Planned
- Po=Potential
- U=Upgrade

**I/F Medium**
- E=Electrical
- F=Floppy
- T=Tape
- H=Hardcopy

**ICD Status**
- R=Red
- Y=Yellow
- G=Green

**Doc. Phase**
- P=Planned
- D=Draft
- C=Completed

# ATTACHMENT 2

## Data Base Report Samples

This attachment contains samples of the Project Schedule, Dependency and Independency Status Reports used to prompt data collection and support DS-SIMO analysis.

I2/DSNET 3 Schedule Status Report
03/31/91

| Milestone | Baseline | Current Estimate | Actual | Status |
|---|---|---|---|---|
| 520 (V5 - O&M) | / / | / / | / / | NO BASELINE |
| All site TN3270 Access-DIA IBM | / / | / / | / / | NO BASELINE |
| 520 (V1 - 5 year plan) | 01/16/90 | 02/01/90 | 06/15/90 | COMPLETED |
| 520 (V2 - Interop'bility Test) | 01/16/90 | 01/22/90 | 06/01/90 | COMPLETED |
| 520 (V3 - Ethernet Conversion) | 01/16/90 | 02/01/90 | 06/01/90 | COMPLETED |
| 520 (V4 - NTC Contract Support | 01/16/90 | 02/01/90 | 07/09/90 | COMPLETED |
| Terminate I2 Circuits | 06/30/90 | 08/15/91 | / / | SLIPPED |
| Finish Modelling (First Phase) | 07/01/90 | 07/01/90 | 08/15/90 | COMPLETED |
| Finish NMIC Gateway Conversion | 07/31/90 | 08/30/90 | 08/30/90 | COMPLETED |
| NTC Upgrade Engineering Model | 08/01/90 | 01/18/91 | / / | OVERDUE |
| Finish Interop'ility Test (V2) | 09/30/90 | 09/30/90 | 09/30/90 | COMPLETED |
| Finish Ethernet Conversion(V3) | 09/30/90 | 06/30/91 | / / | SLIPPED |
| Terminate NTC Contract Support | 09/30/90 | 06/30/91 | / / | SLIPPED |
| 5 Year Plan Complete | 02/01/91 | 02/01/91 | / / | OVERDUE |
| Complete NTC Upgrades | 03/31/91 | 05/31/91 | / / | SLIPPED |
| TN3270 Access to COINS | 06/21/91 | 06/21/91 | / / | OK |
| DIA I2 Shutdown | 08/31/91 | 08/31/91 | / / | OK |
| Terminate O&M Contract (V5) | 06/30/92 | 06/30/92 | / / | OK |
| Finish I2/DSNET Conversion | 06/30/92 | 06/30/92 | / / | OK |

03/29/91/09:58:43

I2/DSNET 3 Dependency Status Report
03/31/91

| ependent Project<br>Dependent Milestone | Baseline | Current | Actual | Status |
|---|---|---|---|---|
| I2/DSNET 3<br>DIA I2 Shutdown | 08/31/91 | 08/31/91 | / / | OK |

| Independent Projects<br>Independent Milestone | Baseline | Current | Actual | Status |
|---|---|---|---|---|
| DIAOLS<br>Terminate Ext Online Service | 03/31/91 | 03/31/91 | / / | IMPENDING |

03/29/91/10:16:15

I2/DSNET 3 Independency Status Report
03/31/91

| Independent Project<br>Independent Milestone | Baseline | Current | Actual | Status |
|---|---|---|---|---|
| I2/DSNET 3<br>TN3270 Access to COINS | 06/21/91 | 06/21/91 | / / | OK |

| Dependent Projects<br>Dependent Milestone | Baseline | Current | Actual | Status |
|---|---|---|---|---|
| DIAOLS<br>Terminate Ext Online Service | 03/31/91 | 03/31/91 | / / | IMPACT |

03/29/91/10:10:32

# ATTACHMENT 3

## 1.0 Project Management Model

This attachment describes a model of project management with which DIA-ISS requirements were evaluated and on which the SIMOCODE design is based.

## 1.1 Introduction

The system management problem has many dimensions and the successful system or program manager (PM) must have access to data that reflects all facets of these many dimensions. As will be demonstrated shortly, the system management task is very complex and very dynamic. Any automated system that hopes to track this process must be capable of handling both the complexity and the dynamics while bringing coherency to a process that drives toward incoherency. In addition, many systems are being collected into systems of systems. The development of local and wide area networks allowed previously standalone systems the opportunity to communicate with other systems. Initially these networks only served as a communications link. Now, however, the trend is toward the network using the synergistic interactions of the subordinate systems to provide a function much greater than the sum of the subordinates. Phasing individual system modifications and upgrades now becomes a significant task. The manager's need for useful and timely information likewise becomes more demanding.

Central to any management information system (MIS) is data. There is a tendency for MISs to require the project management team to spend more energy supplying data to the MIS than the team saves because of the MIS. This tendency leads toward old and unreliable data in the MIS and a general distrust and eventual disuse of the MIS. To counteract this situation, the MIS must provide a needed product to every member of the program management team who is expected to keep part of the data base current. The design of such a system must satisfy the needs of many disciplines and be usable at many levels of management. A model of project management that is applicable to the subsystem, s' tem, or system of systems levels is the Project Management Dynamics Model.

1.2 Project Management Dynamics Model

The Project Management Dynamics Model depicts the relationships of cost, schedule, and technical performance at all levels and at all phases in the life of a project. The model emphasizes the need for coherence between these three attributes throughout the life cycle of the system and uses a "three-armed balance" analogy to show these relationships (Figure A3.1).

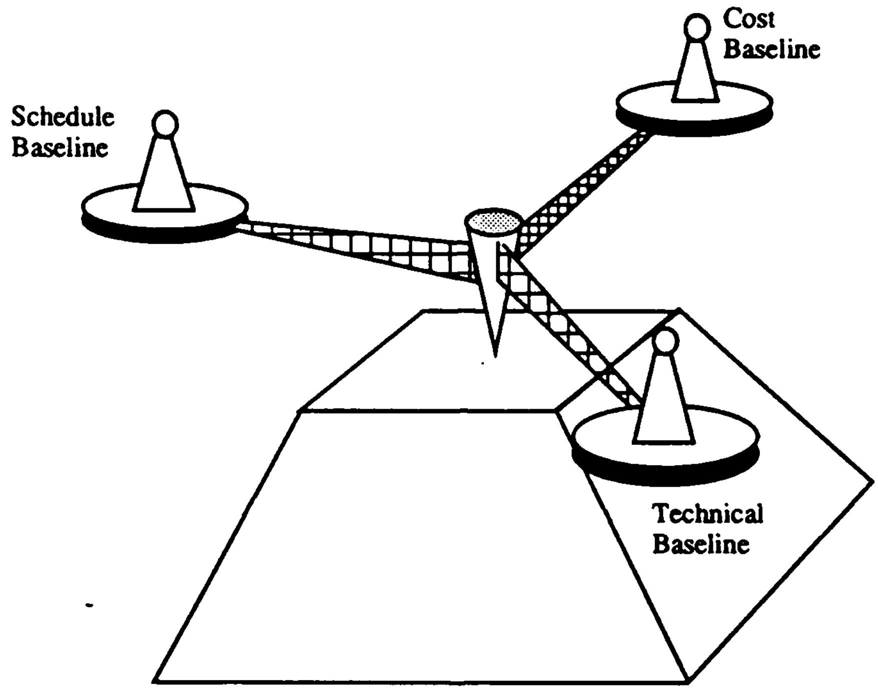


Figure A3.1

The Three Arm Balance
Model of Program
Management

Numerous disciplines and a variety of tools provide data to each arm. Likewise, each arm is the source of data for many reports required of the project management staff. For example, the cost arm receives data from or provides data to cost estimating techniques, accounting systems that track funds status through budgets, commitments, obligations, expenditures, and disbursements by category of funds and fiscal year. Disciplines and tools that define, allocate, trace, test, and track requirements and performance throughout the life of the system support the performance arm. Disciplines and tools that identify and

track schedule milestones, critical paths, and dependencies from concept development through decommissioning support the schedule arm. Figure A3.2 shows an array of disciplines and tools supporting the three arm balance.

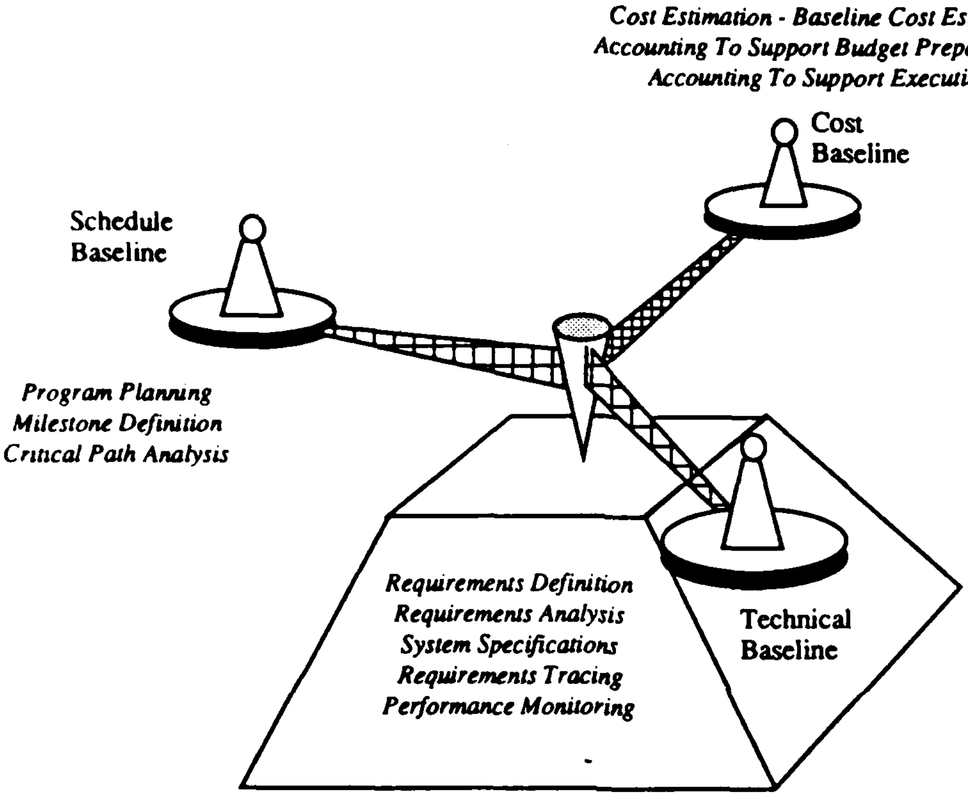


Figure A3.2

Other Tools Supporting the Three Arm Balance Model

### 1.2.1 Balancing, Tipping and Rebalancing the Scale

#### 1.2.1.1 Balancing the Scale - The Program BaseLine

The scale is balanced when cost, schedule and technical performance are all achievable simultaneously (Figure A3.1). When balanced, cost, schedule and technical performance at this level are said to be coherent. Ideally this is the baseline established at program initiation. As the program progresses and deviates from the baseline, variances are generated which act as weights on the arms of the scale causing it to tip (Figure A3.3).

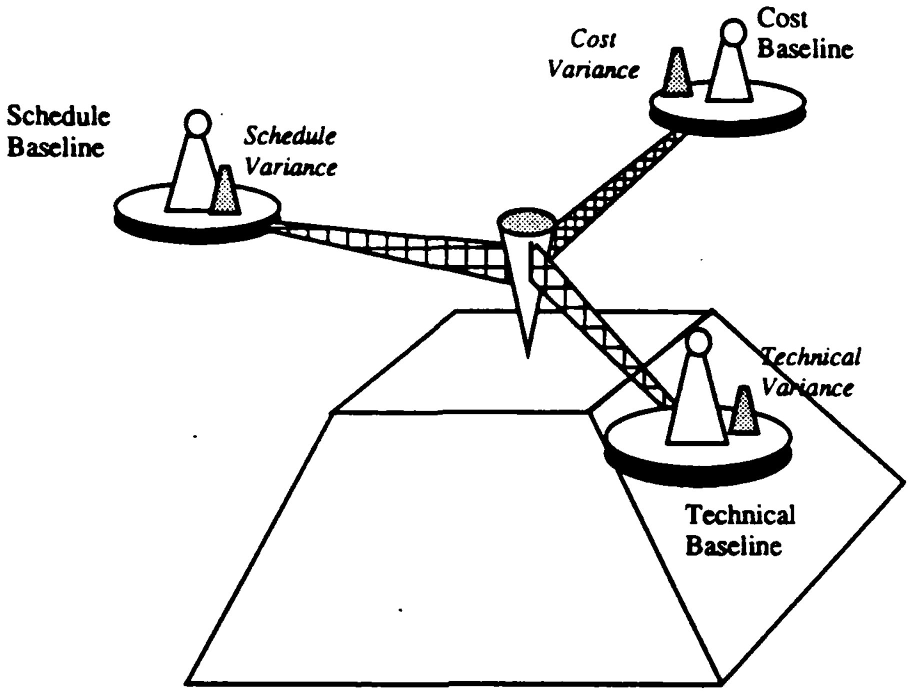


Figure A3.3

The Three Arm Balance
With Variances

### 1.2.1.2 Tipping the Scale - Variances

As the program deviates from the baseline and produces variances, these variances act like weights that tip the scale. How much weight is produced by these variances is regulated by the difference between the baseline and actual or new, current estimates. For example, suppose an important design review slips. If the new date is still earlier than the baseline, the trend is noted but no action is taken. If the date approaches or slips past the baseline, decisive action is needed. Similar arguments apply to the cost and performance arms.

1.2.1.3 Rebalancing the Scale - More Variances

Recovering balance requires one of two actions, remove the initial variance or add compensating variances to the other arms. Sometimes a variance can be spotted quickly and its cause removed. In these cases, balance can again be achieved quickly and easily. More often, however, a solution is more elusive or requires more drastic measures - adding variances to the other arms to recover balance. The following examples illustrate:

a. The program experiences a budget cut. The cost arm now has a variance and the relationship of cost to the schedule and performance baselines is not coherent. Rebalancing means eliminating capability (performance) and changing schedule. The new baseline may reflect unfunded requirements but the program is balanced.

b. Preliminary design indicates a particular performance parameter cannot be met. Additional cost and schedule might solve the problem as will a lessening of the requirement. This example could be the result of a poorly designed baseline (it wasn't balanced in the first place) or poor execution of a properly balanced baseline (the designer was incompetent).

Notice that in both examples a balance results from an added variance on all three arms (Figure A3.3). After many perturbations, these accumulated variances translate to cost overruns, late deliveries, and below standard performance when compared to the original baseline. The object of program management is to maintain balance while minimizing the variances.

At this point the model can be used to assess risk and risk reduction actions. By tracking historical trends and determining sensitivities to those trends, high risk and high sensitivity combinations can be mitigated through close monitoring, redesign, or other appropriate action. Adding another level of sophistication to the model, e.g., transfer functions between the arms, can allow the PM to predict the required values of the compensating variances. This can allow automated support to "what if" analyses. The concept of transfer functions is addressed in Paragraph 1.4 of this attachment.

## 1.3 System Integration Dynamics Model

The Project Management Dynamics Model just described only addresses the dynamics internal to the project being developed. When integrated into a larger system, a project will interact in some way with other projects. Expanding the project management dynamics model slightly forms the basis for the System Integration Dynamics Model.

### 1.3.1 Interfaces

Consider two projects each at different points in their life cycle. The project management dynamics models may look like Figure A3.4

If these projects will eventually produce systems with a formal technical or performance link, commonly called an interface, we depict that interface on the model by joining the two technical performance arms. This signifies that the two projects have interrelated dynamics on the technical arms. Now when one project experiences a variance, the other may also. The degree of impact on the second project will be affected by many parameters to be discussed shortly.

### 1.3.2 Dependencies

Now suppose there is no interface between the two projects but one still depends on the other for some service. A case in point is the retirement of an aging, hard to maintain system and replacement by new equipment and software. Before the old system can come down, the new system must assume some or all of the functions of the old system as well as demonstrate any new functions. The Project Management Dynamics Model depicts this relationship as shown in Figure A3.5.

Now the projects are linked at the schedule arms by schedule events - that is, one project depends on another for a function, event, or item before the first project can continue its life cycle. This relationship is called a dependency. The Independent Project is the one providing the object of the dependency and the Dependent Project receives the object of the dependency. In our example, the aging equipment milestone might be system termination (the dependent milestone) and the new equipment's initial operational capability (IOC) milestone might be the independent milestone. If the new equipment experiences variances that delay IOC, the aging equipment is impacted because it must remain operational longer at increased program costs and delay in schedule.

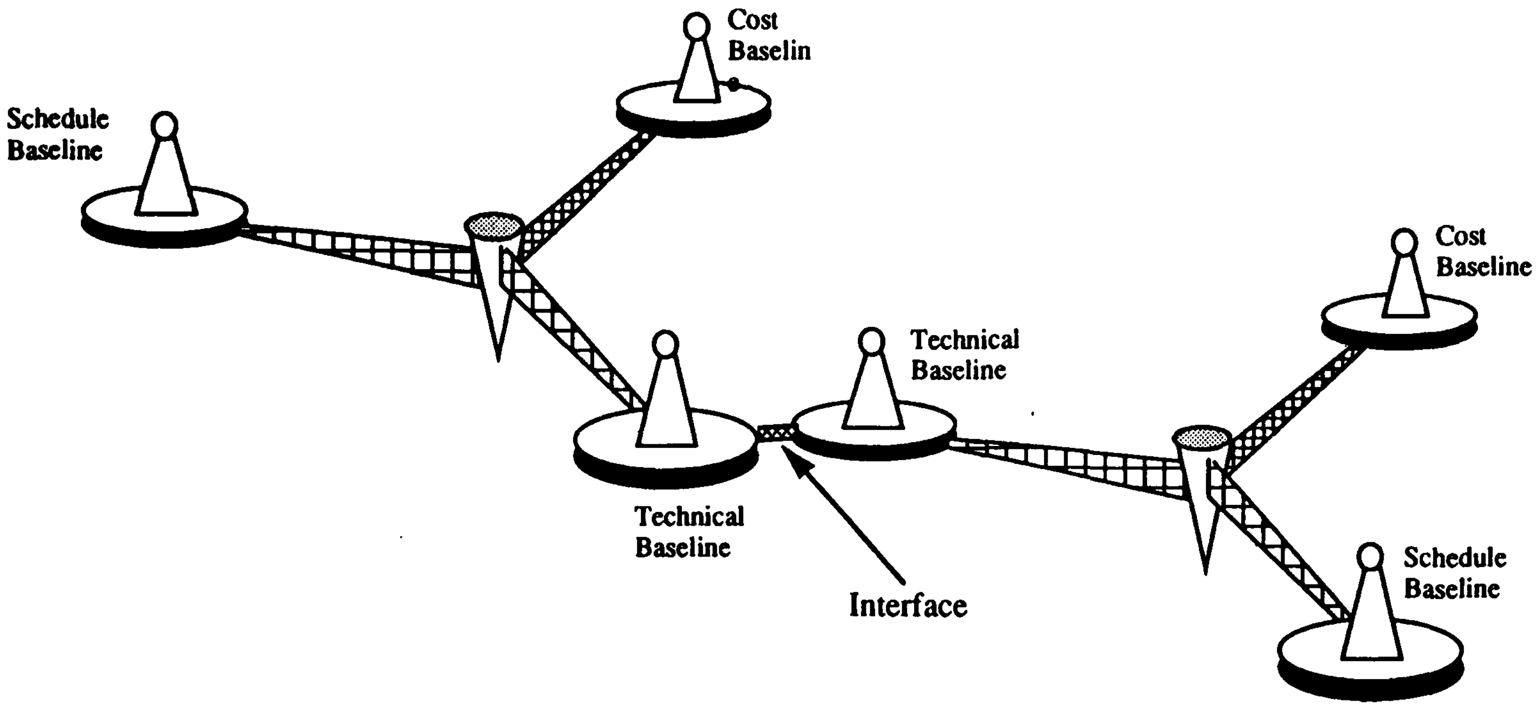


Figure A3.4

Two Projects With An Interface

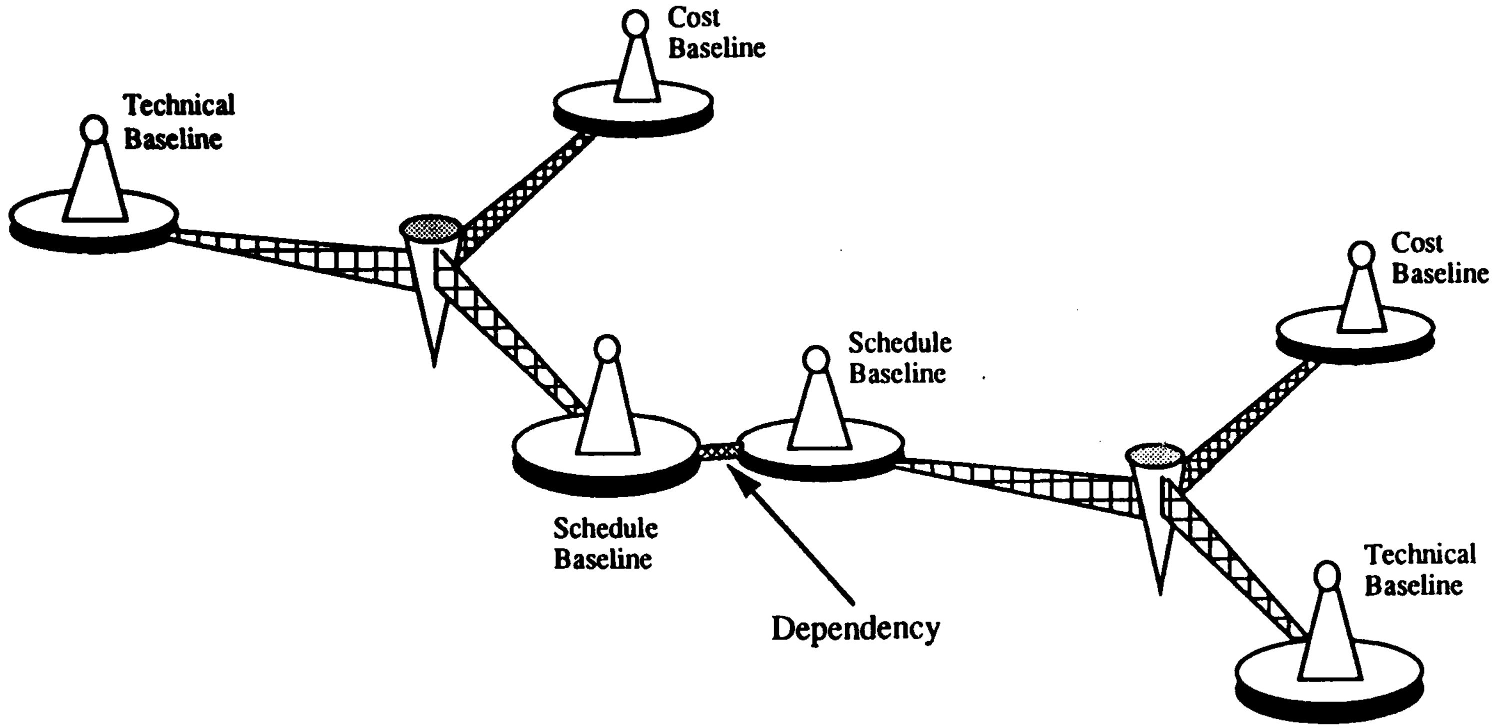


Figure A3.5

Two Projects With A Dependency

Interfaces and dependencies are documented by Interface Control Documents (ICDs) and Dependency Control Documents (DCDs) respectively. The details of interfaces and dependencies are worked out in interface control working groups (ICWGs) and dependency control working groups (DCWGs).

As a system, particularly a network, grows in capability or over time, the number and nature of projects changes as do the number and nature of dependencies and interfaces. The integration manager must have a model that helps account for the complex dynamics and provides a measure of control to the network upgrade. This is provided by the Transition Increment Dynamics Model.

### 1.3.3 Transition Increment Dynamics Model

The Transition Increment Dynamics Model (Figure A3.6) depicts the asynchronous nature of the numerous program schedules comprising a larger, mega-system. Individual programs may be ready for initial or upgraded operations on substantially different schedules. Dependencies and interfaces will determine whether and to what extent other projects are impacted. The Transition Increment Dynamics Model allows maximum possible independence for the component programs while assuring the mega-system evolves in a beneficial and planned manner.

Transition Increments are treated as programs in their own right complete with dependencies but generally without interfaces. The Transition Increment manager is responsible for regression testing, integration, and similar activities as well as certifying the mega-system upgrade has met its requirements without adverse impacts.

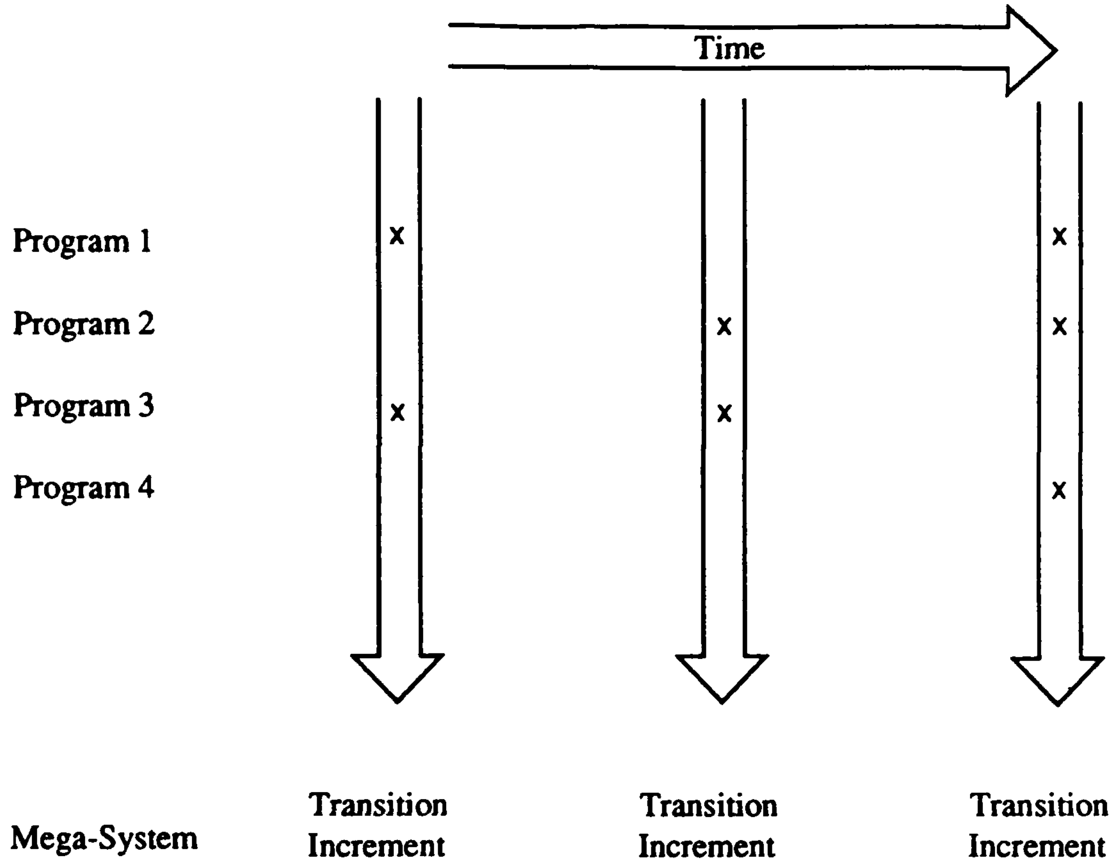


Figure A3.6

TRANSITION INCREMENT DYNAMICS MODEL

## 1.4 Project Management Development Model Extended for Large Programs

Large programs are characterized by two or more projects with a sophisticated set of performance requirements, a budget that extends over several years with more than one category of funding, and an extensive and interrelated set of schedule events. Managing these programs requires the PM to break each of these areas down into smaller, easier to comprehend pieces.

### 1.4.1 Work Breakdown Structure

Complex programs must be broken into small pieces to facilitate understanding and tracking. The orderly decomposition of the total project into small pieces

that can be reliably scheduled and costs estimated is done through the work breakdown structure (WBS). These bite-sized pieces will each have a technical, cost, and schedule standard associated with them. The program then manages total performance, cost, and schedule through the levels of the work breakdown structure.

### 1.4.2 Organizational Breakdown Structure (OBS)

Management is the art of accomplishing an objective through other people. Program management involves an organization with delegated responsibilities. In program management, assigning logical segments of the work breakdown structure to the various organizational entities works best. The organization is defined to a management information system by the organizational breakdown structure and each element in this structure is assigned one or more segments of the work breakdown structure.

### 1.4.3 Cost Breakdown Structure (CBS)

The cost arm is organized according to a cost breakdown structure (CBS), which is then applied across the WBS. The CBS tracks past, current, and future costs by category and year for each element of the WBS. The CBS supports the Planning, Programming and Budgeting System (PPBS) as well as the accounting and finance activities required for appropriated funds. A baseline cost estimate, organized in the same manner, serves as the standard for measuring variances.

With a WBS and a CBS defined, cost elements to the level of detail required can be identified and tracked in a matrix similar to that below:

```
                         CBS
          ------------------------------
          |
          |
          |
   WBS    |         $$
          |
          |
          |
          |
```

Figure A3.7 - CBS:WBS MATRIX

### 1.4.4 Schedule Breakdown Structure (SBS)

The schedule arm is organized according to a schedule breakdown structure (SBS) which is also applied across the WBS. The SBS tracks key milestones required by regulation, experience, or user needs. All activities conducted in support of the program will directly support one or more of these milestones (Figure A3.8).

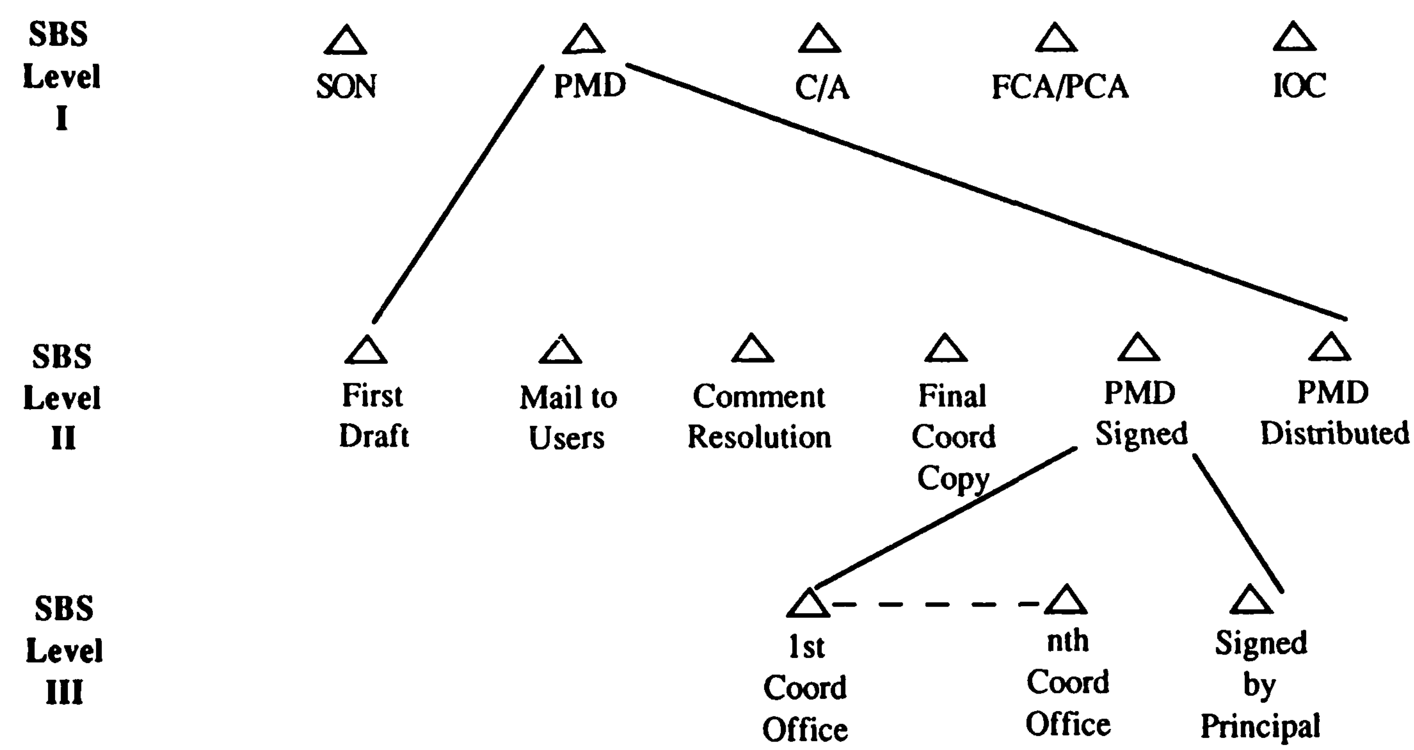


Figure A3.8
Example of a Schedule Breakdown Structure

With an SBS defined, each element of the WBS can now be scheduled resulting in the following matrix:

```
                         SBS
          ------------------------------
          |
          |
          |
WBS       |         Dates
          |
          |
          |
          |
```

Figure A3.9 - SBS:WBS MATRIX

The matrix of cost versus schedule could also be developed at this point. This matrix would be useful for developing algorithms to estimate the cost impact given a schedule change or vice-versa. This is the beginning of the [cost:schedule] transfer function in the Project Management Dynamics Model.

### 1.4.5 Technical Breakdown Structure (TBS)

The technical arm is organized according to a technical breakdown structure (TBS) that, again, is applied across the WBS. The TBS identifies key performance needs of the user and allocates performance requirements to components of the system through the Work Breakdown Structure (Figure A3.10).

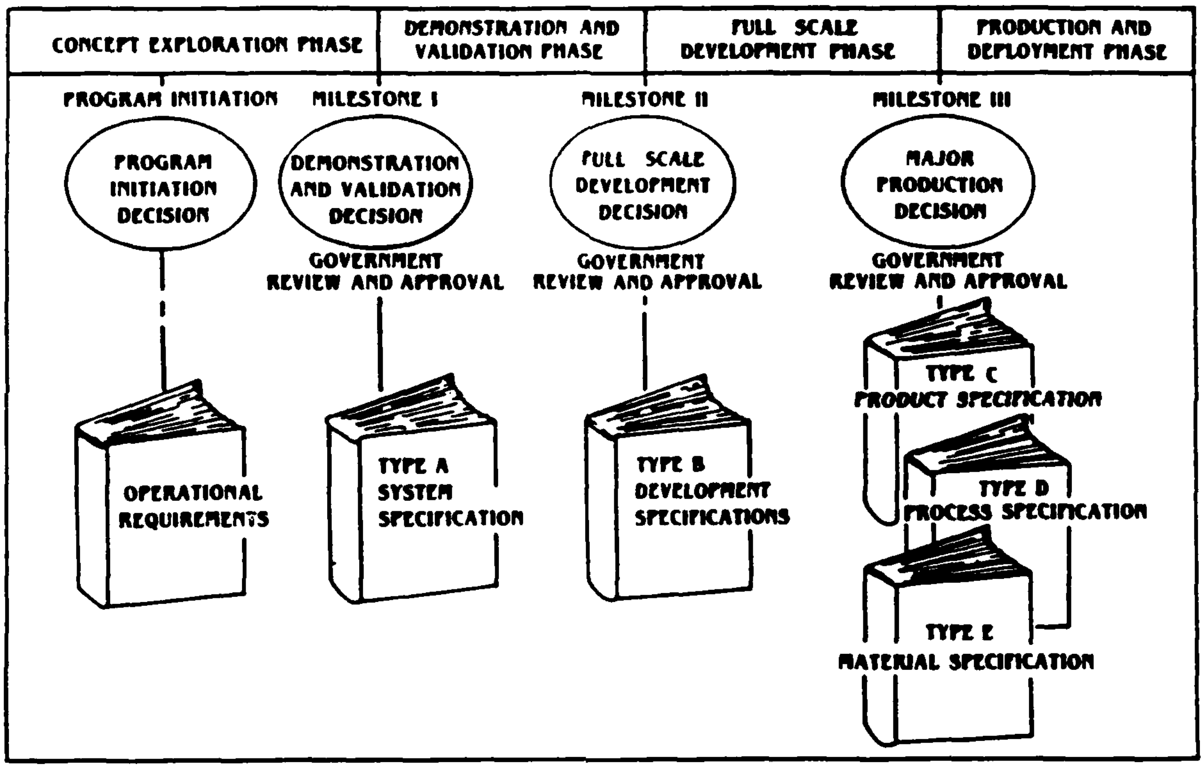


Figure A3.10
TECHNICAL BREAKDOWN STRUCTURE DEVELOPMENT
BY WAY OF SPECIFICATION ALLOCATIONS

Now the WBS:TBS matrix can be developed that will contain the key performance requirements of the system or systems.

| | TBS |
|---|---|
| WBS | Performance Values |

Figure A3.11 - TBS:WBS MATRIX

With the WBS:TBS matrix now defined, the two remaining transfer functions, [TBS:SBS] and [TBS:CBS], can be determined.

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## OF

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